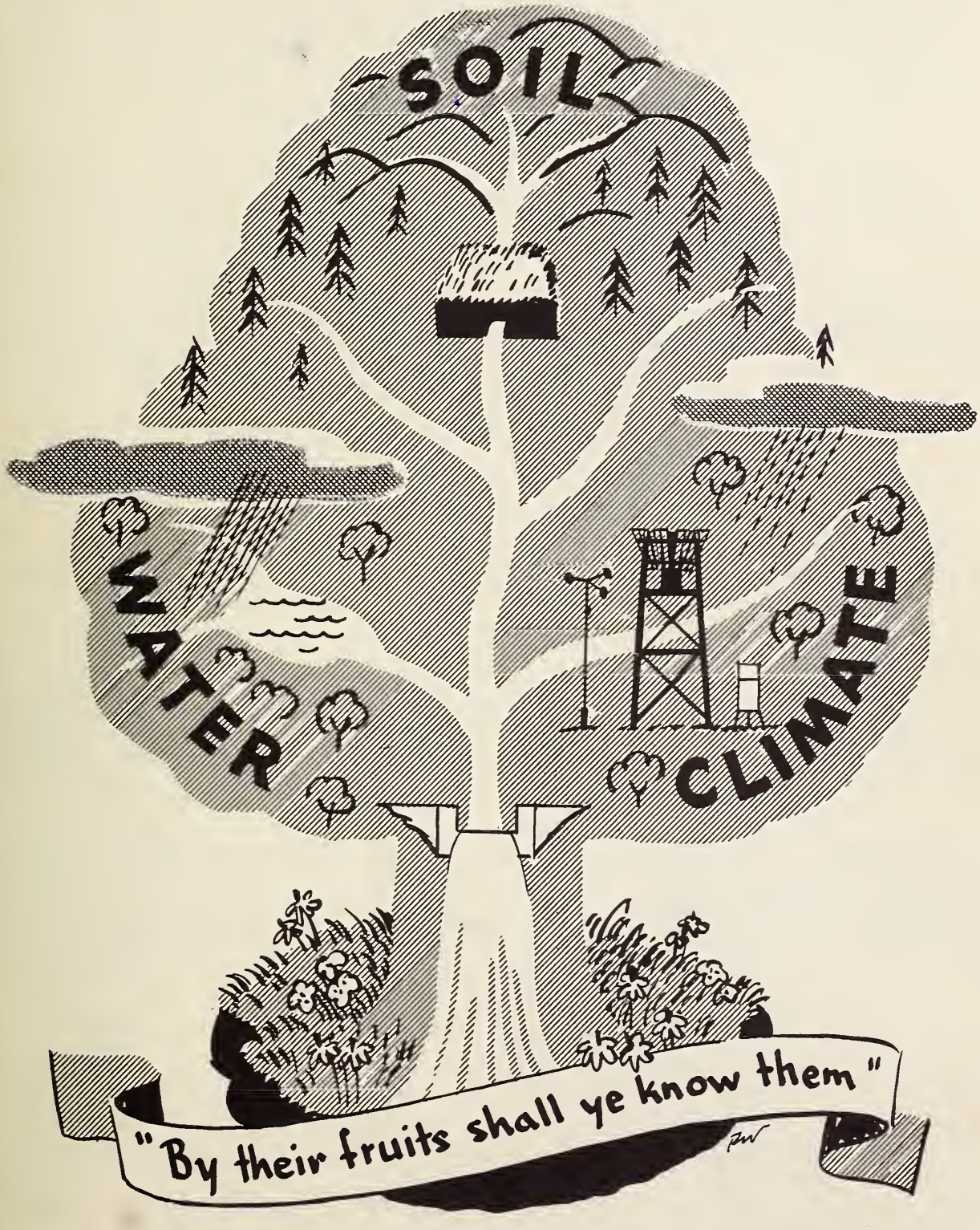
DIVISION OF FOREST INFLUENCES

Quarterly Report



U. S. DEPARTMENT OF AGRICULTURE

FOREST SERVICE

January-March 1951

FOR IN-SERVICE USE ONLY

QUARTERLY REPORT
Division of Forest Influences
April 15, 1951

A final check on returns from the questionnaire on the bimonthly report has been made. Results are interesting. The composite worker in our Division wants a periodic report, believes it should be issued every 3 months (which it will be), considers it a "good" report, has benefited by it, has not written to anyone about it, and sees most of the publications listed. He reads an average of 3.4 popular magazines, 6.8 journals, and 12.0 books a year. He does not regularly read a foreign language, patronizes libraries, belongs to 2 professional societies, 1 non-professional, and has 2 hobbies. Considerable variation exists around this composite figure; the above values have no statistical significance.

A total of 66 answers was received; of these, 63 wanted a report, 3 didn't. Other issues were not so clear-cut. For instance, how often the report should be issued and reaction to the report were as follows:

Issued		Reaction	
2 months	11	Excellent	6
3 "	31	Good	41
4 "	5	Fair	11
6 "	12	Poor	0
Undecided	4	Unsatisfactory	2
Never	3	Undecided	6

Sixty-one had been benefited by the report, 3 had not, 2 undecided. Nineteen had written to other workers for more information, 47 had not. As to seeing the publications listed, the vote was most - 32, some - 24, few - 7, none - 0, undecided - 3.

Fiction, detective, history, and forestry led the list of books read with considerable variation in numbers and subject matter. Among the popular magazines, the Luce publications came in first closely followed by the Saturday Evening Post. Altogether 38 titles were listed. The top 10 magazines and number of readers are as follows:

Life	35	Harpers	11
Time	33	Colliers	9
Sat. Evening Post	32	Field & Stream	9
Readers Digest	19	Nat. Geographic	9
Newsweek	15	American Forests	5

A comparable tabulation of journals:

Journal of Forestry	60	Ecology	36
Journal of Soil & Water Conservation	45	Scientific Monthly	32
Soil Science	44	Biblio. of Agriculture	23
Biological Abstracts	40	Transactions A.G.U.	20
Science	38	Journal of Range Management	19

(Over)

Only 5 regularly read foreign languages, only 2 do not patronize libraries. More are members of the SAF than of other professional groups, with AGU coming next, and Soils third. The top half-dozen are:

SAF	49	Soil Cons. Soc.	9
AGU	30	Sigma Xi	7
Soil Science	12	AAAS	6

Exactly half of the replies indicated membership in non-professional groups, with fraternal, luncheon, and civic organizations most popular. Hobbies were many and varied. A total of 34 were listed, only 4 men had no hobby. The first six were:

Photography	31	Minerals	9
Wood working	19	Gardening	8
Fishing	11	Metal working	6

With about half of the questionnaires came comments and suggestions as to the material in the report. Following are some verbatim extracts:

....some stations have expanded this [bimonthly report] into detailed reports which approach the nature of study progress reports.... the bimonthly report should be a brief and concise statement of divisional activities...

....Too much space devoted to recording the diaries of people.... reducing Stations to 2 pages would squeeze out the dross...

....small but interesting and significant technical findings or observations should have precedence over the general progress statements....

....[the periodic report] should invite discussion on specific points.. present difficulties encountered...ask suggestion for their solution. It should make it possible for the research worker to ascertain where problems of different Stations dovetail or run along parallel line... should make available to him results, however tentative, while they are being obtained... there ought to be an obligation on the part of other workers to comment on the subject matter...

Some of us, in months when concrete accomplishments are slight, are inclined to devote too many pages to routine and trivial matters. Too much of this will defeat the purpose of the report for nobody will bother to read it.

....I look forward to each report as a means of keeping abreast of research.

Believe it takes a little time for a unit to get into the swing of putting out useful items...

The reports serve a real need...too lengthy and could be made more readable.

....[Give] less detail on work routines and more on methods and results of individual studies.

Too many diary reports, detailed climatic records, etc.

Too many extraneous items. Should deal only with research - not number of visitors, meetings, etc.

....more information should be included on methodology and procedures, particularly in regard to gadgets. Improvements and failures as well as successes should be reported.

....I saw [the report] as a means of exchanging ideas, as a means of avoiding "instrument lag" between the fruition of research and the publication of research, and as a stimulus to new approaches to our problem. The first one or two reports that came out had strong elements of these things in them. The later reports read like expense account vouchers...there is too much of a "secret knowledge" attitude among our research workers....

Reports should keep us informed as to the activities of our co-workers, many of whom are personal friends. They should be forums, where common problems can be presented, clarified, and solved. And they should tie all of us into a well-knit organization.

I can't get too excited about the number of meetings..., or the amount of precipitation, or that so-and-so is writing a report. I am interested to know the type of work being done....

We have finally undertaken a cooperative study with the Army (Army supplies the funds, we do the work) to determine the effect of soil moisture on various physical properties of the soil. Dortignac is heading up the work with field headquarters at New Orleans, La. So far the 11 men employed on the project are on a temporary basis until the end of this fiscal year. Some are on detail from FS and SCS; others appointed. If funds are made available to carry the project through next fiscal year, work will be extended into other regions. Dort's paper on Infiltrometers is now available: ask your Station for a copy.

The President's Water Resources Policy Commission went out of business on March 4 with publication of the last volume of their 3-volume report. The President has requested Federal agencies to study the report from the standpoint of how to implement the Commission's recommendations. Separates of the individual river basin reports of Volume II have been ordered for use of the Stations and all research centers.

The Roosevelt study has been completed, discussed with the staff, and findings presented to a joint meeting of the Foresters and Directors. According to the final report the present condition of the watershed is due more to past history than recent usage with much of the watershed damage due to mistreatment of the forest area. Roads have been and still are a source of damage, contributing to gully-cutting runoff. Due to heavy stock reductions the general trend of range condition is upward. The report will have a limited in-Service distribution.

Recently, the Army Engineers have evinced a greater interest in land treatment programs, particularly in regard to the use of erosion control structures and small dams. An effort is being made to work out the respective spheres of influence of the Army and the Department in work of this kind under the Flood Control Act.

The Conservation Foundation has announced that results of their groundwater study will be published in April under the title Conservation of Ground Water (McGraw-Hill). The author, Dr. Harold E. Thomas of the Geological Survey, has drawn heavily on Forest Influences findings to illustrate his chapter on the effects of land use on water supplies. Munns served on the Conservation's board of review for this project. Another major study now being planned by the Foundation concerns the effect of vegetation on the disposition of water, soil moisture, and stream flow.

This is our first Quarterly Report. No change in editorial policy is contemplated. This report is yours. What it contains will be only as good as you make it. Your fellow workers think so too.

QUARTERLY REPORT, DECEMBER 1950 - MARCH 1951, inclusive

Forest Influences Division
California Forest and Range Experiment Station

1. General

a. The Water Situation. California has again gone through a winter of unusual weather. Rainfall has been well above normal in the northern and central parts of the State, but the southern San Joaquin Valley and all of southern California have received only about half of their normal rainfall. The heavy rains that visited the Sierra Nevada between October and December brought severe floods in the Central Valley, and streamflow has remained relatively high since then. The lower-than-normal snow pack in the Sierra, coupled with abnormal winter rains suggests that high streamflows will continue during spring and early summer, but that late summer and fall flows may be lower than normal.

From southern California come reports of severe local water shortages. Santa Barbara is pumping heavily in new and old wells in the coastal plain in order to save the flows now entering Gibralter Reservoir. Nearby Montecito is reported to be rationing water. Big Tujunga Reservoir, above San Fernando, is nearly dry. Only small pools of water remain in Big Bear Lake, above San Bernardino, Lake Henshaw, east of Oceanside, and Lake Elsinore, southeast of Corona.

In most of the southern California counties the services of "cloud seeding" organizations have been engaged. Reports of seeding operations have been variable, and, as elsewhere, are difficult to appraise. The salient point at the moment is that southern California is still in the throes of a drought of several years duration, all the efforts of man notwithstanding. Under these circumstances the value of water imported from the Colorado River and Owens Valley can hardly be over-estimated.

b. Soil Stabilization - Shasta Lake Area. As a follow-up of field examinations and conferences held last fall with Forest Service and Reclamation Bureau people (Bimonthly Report, October-November 1950, item 1-c), Kraebel prepared a memorandum report on erosion control in the old smelter-fume area in the vicinity of Shasta Lam. Prepared largely for the benefit of the men in both agencies who are concerned with the current cooperative erosion control activities but who have had no past connection with the area, the memorandum summaries briefly the past planting experiments, and offers recommendations and suggestions for future action.

As with many another influences problem in California, the earliest planting experiments in this area were done by E. N. Munns, in 1922 when he established some 25 plots of grasses, shrubs and trees.

A number of walnut, locust and pine trees resulting from those tests were measured in 1939, but four years later all the plots became part of the floor of Shasta Lake when Shasta Dam was completed. In 1933 Kraebel's interest in reforesting the smelter area was aroused by reports, from Wieslander's type-mapping crews, that natural conifer reproduction had been found among the gullies and the thin cover of manzanita and poison oak. After a small preliminary planting test the Division of Forest Influences, between 1933 and 1938 put in extensive sowing and planting experiments on some 700 acres of the area, aided by labor and funds from the Civil Works Administration, and the Civilian Conservation Corps. In the fall of 1949 the Bureau of Reclamation and the Shasta National Forest began their current cooperative project, which at this writing has already accomplished the planting of half a million pine plants, nearly a million willow cuttings, and the building of more than 20,000 gully plugs and check dams.

The high-lights of recommendations from Kraebel's memorandum are as follow:

(1) Reforestation of the smelter area for the purpose of controlling erosion is possible and practicable without elaborate terracing or other preparation of the soil.

(2) The use of three measures, in combination, is recommended as essential for success, and no one of them alone can do the job:

(a) The planting of conifers, chiefly pines in the form of 1-1 stock, on a spacing of not over 6x6 feet throughout the area, is the most important measure and the one that will provide ultimately the permanent control.

(b) The planting of willows in gullies, by setting cuttings densely during their dormancy, is recommended as an effective means to restrain gully erosion and to bolster the gully plugs and check dams. Detailed directions and precautions are given for handling willow cuttings.

(c) Gully plugs and small check dams of cut brush and tamped earth, or of loose rock when available, placed close together and in large numbers, are needed to retard runoff, trap eroded soil, and prevent enlargement of gullies during the 6 to 10 years required for the planted conifers and willows to establish permanent control.

(3) Intensive fire protection is urged to prevent loss of the present natural cover of shrubs and scattered trees, as well as the large investment in planted trees and gully structures. A large fire would give the area a disastrous set-back and might make its reclamation altogether impractical.

(4) The planting of ground cover vegetation, though desirable, is not recommended for several reasons: planted pines succeed without it; an erosion pavement of rock fragments exists over much of the area and now protects the soil; past tests with some 30 grasses and other ground cover plants have all failed, indicating the need for further research to find both suitable species and method of sowing; numerous gully systems and steep slopes make ground preparation by machinery impractical.

c. Flood Control Research, Los Angeles River Watershed. A plan for soil stabilization studies was presented in the June-July 1950 Bimonthly Report. In January 1951, Flood Control Action funds were made available to the Station, and three studies were initiated under this plan, to be carried on during the remainder of the fiscal year:

(1) A soil movement survey, to study the various processes of soil movement on steep slopes, the conditions under which various kinds of soil movement occur, and means of recognizing them and estimating their rates.

(2) A study of the rooting characteristics of chaparral plants, and the effect of soil depth and underlying rock structure upon root development.

(3) A search of native and exotic flora for plants that offer the best promise of usefulness for soil stabilization.

Research in these three studies started in mid-February. John Retzer, soil specialist of the Rocky Mountain Station was detailed to the California Station to take charge of the soil movement survey. He is being assisted by Irving Sherman, soil scientist, detailed from the Arcadia Soils Laboratory of the Forest Service, and four graduate foresters who are in trainee positions on the National Forests of southern California. Gustaf Juhren and James O'Keefe have been detailed from the Los Angeles River Flood Control Project to conduct the root study. They are being assisted by Angeles Forest personnel. Burgess Heacox, who has just received a master's degree in botany at Pomona College is handling the plant search. The Angeles National Forest is providing excellent cooperation and help in several phases of the studies.

Report of progress in these studies will be found under Current Research, below.

d. Fire and Flood (Concluded). Various aspects of the fire-flood sequence on the Jackson Ranch burn of July 4, 1950, San Bernardino National Forest, have been described in previous bimonthly reports, and it was noted that debris measurements were being made. DeMott's survey of the Clyde Canyon channel showed that debris was deposited for a distance of 9,500 feet downstream from the canyon mouth.

Volume of the air-dry deposit was calculated from measured channel cross-sections at 6,725 cubic yards. The burned area from which this debris was eroded amounted to 211 acres, or 0.33 square miles. Thus the erosion rate for the storm of July 6 was 20,175 cubic yards per square mile. The actual flows were undoubtedly greater, owing to entrained water, but the amount of bulking has not been estimated. As reported earlier, rainfall during the storm totaled 0.72 inches, measured by an intensity gage located 3 miles southeast of the burn. Of this amount 0.35 inches came in the first 8 minutes (2.63 inches per hour) and 0.37 inches came in the next 20 minutes (1.11 inches per hour).

DeMott's survey also showed super-elevation of the viscous flow on curves, where highwater marks were consistently higher on the outer canyon walls. In one case a difference of 6.5 feet in elevation was measured in a channel width of 33 feet giving a cross-channel gradient of approximately 20 percent. The already-reported fact that no runoff nor erosion occurred in adjacent unburned canyons that received the same or heavier rainfall was confirmed by DeMott's study.

e. Rust-proofing Metal Tanks. The Dow Chemical Company has developed an electrolytic device to inhibit rusting of metal tanks. This device should be of interest to technicians who employ collector tanks, frequently of complicated design and of costly construction. The device consists of an anode that causes a thin protective film to be deposited on the interior surface of a steel tank filled with water. This anode, marketed under the trade name "Vanode", is an extruded magnesium alloy rod with a steel wire core. The rod is placed in the tank and supported by insulating spacers so that it is equi-distant from the surfaces to be protected. One end of the rod is grounded to the tank by a copper wire.

The device was tried in a badly rusted silt trap from one of the runoff-and-erosion plots on the San Dimas Experimental Forest. The tank, made of galvanized iron, was 32 inches wide, 48 inches long, and 22 inches deep. It was sandblasted and made watertight. An anode 3/4 by 1 inch in cross section and 126 inches long was installed horizontally in the tank 10 inches from the bottom and 3 inches from the side walls. Since this installation in October 1949, a dark gray film, almost black, has developed on the interior surface of the tank with no evidence of rust below the water surface. The electrolytic section does not extend above the water line so it will be necessary to apply some form of waterproof coating to the exposed metal surface.

For additional evidence of the use of an electrolytic process in the protection of metals below water surface in dams and desilting basins, see " Cathodic Protection at Imperial Dam" by Joseph P. Collopy and Waldo D. Freeman, Engineering News-Record, 1/4/51, p. 43.

f. Watershed Cover. A small plantation of hybrid pines has been established at Tanbark Flat. The planting stock was raised at the Institute of Forest Genetics at Placerville. Twenty trees each, of the backcross of Pinus jeffreyi x P. coulteri and P. jeffreyi, and P. ponderosa x P. latifolia, were planted along with trees raised from wind pollinated seed from the parent tree.

g. Instrumentation. A new combination synchronizer-recorder pen has been developed by Andrews and installed on several HCF streamflow recorders of the San Dimas Experimental Forest. By the use of this pen both streamflow and time are recorded along a single line.

2. Current San Dimas Information

a. Personnel.

(1) Horton left Glendora March 12 and reported next day in Vicksburg, Mississippi, for assignment to a cooperative infiltration study being started by the Forest Service and the Corps of Engineers. The exact nature and length of his assignment are not known.

(2) Arthur DeMott, who has been an engineer at the San Dimas research center for many years, accepted a civilian engineering position at the March Field Army Air Base, near Riverside. He transferred to his new position March 26.

(3) In January, Sinclair was detailed, for the rest of the fiscal year, to a survey of watershed conditions in the Santa Ynez drainage (see Cooperation). During his absence Hamilton is in charge of the San Dimas research center.

b. Weather. The southern California drought has now reached a point where records are being shattered rather than merely broken. Rainfall at the Tanbark Flat Field Headquarters totals only 7.77 inches to date, or 0.60 inch less than the corresponding amount of 1898-99, the driest year on record. This value of 8.37 inches for Tanbark Flat in 1898-99 was estimated from the 70-year rainfall record at Glendora. Delving farther into the past we find in a study made by Henry J. Lynch, consulting engineer at Los Angeles, estimates for four other drought years, 1829-30, 1840-41, 1863-64 and 1877-78, all of which are somewhat higher than the 1898-99 measured record. The Lynch tabulation goes back to 1770 and is based on old mission records, diary entries, newspaper stories and such sources of information.

Climatic data for December 1950 to February 1951 are shown in the following table:

Month	Rainfall: 1950	Rainfall: 22-yr av.	Temperature: Absolute Max.	Temperature: Absolute Min.	Temperature: Mean	Temperature: 17-yr mo. mean	Evaporation: 4-ft. Weather Bureau pan 1950	Evaporation: 4-ft. Weather Bureau pan 15-yr. mean
	- Inches -		- - - Degree F. - - -				- - - Inches - - -	
Dec.	0	5.74	84.5	33.5	55.5	49.0	3.18	2.53
Jan.	3.83	4.57	80.5	27.0	46.3	46.5	3.18	2.53
Feb.	1.25	6.45	82.	23.	46.7	46.7	2.47	2.39

3. Manuscripts in Preparation

a. "Rainfall Sampling in Rugged Terrain" by E. L. Hamilton. The subject matter of this paper was presented at the recent meeting of the American Geophysical Union (see Meetings) and the first draft of the paper is under preparation. It presents the results of studies which lead to the recommendation that tilted rain gages be used in mountainous country, and shows how records obtained with vertical gages can be corrected.

b. "Development of Vegetation after Fire in the Chamise Chaparral of Southern California" by J. S. Horton and C. J. Kraebel. Horton's recent return from Colorado (November) and detail to Mississippi (March) has left time for only partial revision of this paper.

c. "Plant Growth and Erosion in Two Chaparral Burns in Southern California" by C. H. Gleason. This paper is now undergoing review by the Station staff.

d. "Evaporative Water Losses from Ponderosa Pine Litter" by T. M. Hendrix and P. B. Rowe. Data analysis is complete and writing of the first draft is under way. This paper will report interception and evaporative losses from various depths of pine litter at Bass Lake, Sierra National Forest. It will also present data on the influence of litter cover upon surface runoff, erosion, and evaporative losses from the underlying soil.

e. "Changes in Vegetation Following Burning in Two Woodland Brush Types" by T. M. Hendrix. A work outline for this paper has been prepared, and data analysis is well under way. This paper will describe changes in vegetation cover which have occurred as a result of repeated burning of the North Fork runoff plots in the period between 1930 and 1950.

4. Papers Completed

a. "San Dimas Rainfall and Wind Velocity Recorder" by E. L. Hamilton. Published in the Bulletin of the American Meteorological Society, January 1951.

b. "The Calibration of Fiberglas Soil Moisture Units" by T. M. Hendrix and E. A. Colman. Accepted for publication in Soil Science; will probably appear in the June issue.

c. "Interception of Rain and Snow by Second Growth Ponderosa Pine" by P. B. Rowe and T. M. Hendrix. Presented at the February meeting of the A.G.U. and submitted for publication in the Transactions.

d. "Some Aspects of Watershed Management in Southern California" by the Forest Influences staff. This collection of discussions was prepared in 1947 for a meeting of National Forest supervisors on the San Dimas Experimental Forest. It is now being re-issued by the Station in multilith form in order to satisfy requests for it that continue to be received. Copies will be available for distribution in mid-April.

5. San Dimas Research Conference

Current research activities and future plans for the San Dimas Experimental Forest were discussed at a staff meeting in Glendora, February 26 and 27, attended by Wyckoff and Colman. In addition to matters considered elsewhere in the present report the following subjects were discussed:

Hamilton reported a test of Fourcade's equation for correcting the catch of vertical rain gages. The usefulness of the equation was tested by an analysis designed to bring out the possible need for additional elements as, for instance, storm size. Data from 13 vertical gages paired with tilted gages and gathered over a period of years were studied. This gave a sample of about 300 observations representing varying conditions of gage exposure and many types and sizes of storms. The tilted gage catches in this sample totaled 833 inches, while the vertical gage catches totaled only 655 inches, a difference of 178 inches or 21 percent. By use of the equation, tilted gage values were computed from the vertical gage catches in this sample. The computed values differed from the observed values by only 9 inches or 1.1 percent, showing that the equation was useful through a wide range of conditions.

In addition to his rainfall sampling report, Hamilton has two other manuscripts in preparation. One of these will be a short paper describing the fabrication of the lucite rainfall graduates used on the San Dimas. The other will give the results of a study carried on

by Andrews on the use of oil to control evaporation from rain gages. This work and administrative duties will require the full time of Hamilton until July. After July he will cooperate with Sinclair in the preparation of a descriptive report (including general results and a bibliography of publications) on the San Dimas Experimental Forest.

Rowe suggested the preparation of two papers: (1) "Water Retention Capacities of Soil and Rock in Southern California Watersheds". This would introduce the concept of temporary retention of rainwater in rock substrata of watersheds and show methods of its determination by use of San Dimas and fire damage appraisal data. It was suggested that the paper should also include analyses to indicate rates and amounts of subsurface yields. (2) "Channel Interception, its Magnitude and Importance in Hydrograph Analyses". As the title suggests this paper would illustrate the range and magnitude of channel interception in southern California watersheds, and demonstrate its importance and application in problems of watershed management involving hydrograph analyses. San Dimas data would be used.

Hellmers and Ashby reviewed the status of the plant physiology work now under way. Topics considered were nutritional studies of native and introduced plants on native soils, controlled environment studies on grass species, transpiration studies, brush conversion to grass, Arctostaphylos and Eriodictyon seed germination, and Pinus coulteri seedling survival.

The nutritional study is to continue both in the greenhouse and in the field. An experiment is to be outlined and started for testing the fixation of nitrogen by members of the genus Ceanothus. A study of effects of watering on growth of native chaparral is to be undertaken using the band of native vegetation that is watered through the dry season by the California Institute of Technology Jet Propulsion Laboratory in the Arroyo Seco.

Long Range Planning, including a discussion of the kind of research that should and could be carried on from the San Dimas Work Center, took up the last half day of the conference. It was agreed that new research should be preceded by the development of a new overall work plan for the San Dimas Center. Such a plan is to be started by Rowe and will be the subject of discussion in future staff meetings.

6. Current Research

a. Rainfall. Now that the usefulness of Fourcade's corrective equation has been demonstrated, work has been started on the correction of vertical raingage records on the San Dimas. Also started was the compilation of rainfall intensities for the Tanbark Flat raingage, using USDA "Precipitation Intensity Record", Form 4.

b. Streamflow. Tables of daily average discharge (c.f.s.) have been completed for sixteen years of record at gaging stations I, II, III, IV, IX and X, and for shorter periods of years at all other stations on the San Dimas. The preparation of these tables is continuing.

c. Lysimeters. Two of the large lysimeters that formerly had an Eriogonum fasciculatum cover, were planted to native bunch grasses. Clumps dug from natural stands near Tanbark Flat were divided into suitable pieces and were planted at 1-foot spacings. The species used were: Stipa lepida, Melica imperfecta, Poa scabrella, and Agropyron caninum.

A summary describing changes in the vegetation cover on the San Dimas lysimeters has been prepared by Horton. In general crown cover and litter densities have increased. However, there have been so many deaths of Ceanothus that cover density has decreased in several of these tanks. Inasmuch as the dead shrubs occur principally in groups, the possibility of disease is being investigated.

Additional fiberglas soil moisture units have been purchased and plans made for the installation of a stack of 8 units in one tank of each of the lysimeter treatments. Because of the shallow depth of moisture penetration this season (12-18 inches in March), no attempt has been made to check the soil moisture units now in place by soil moisture sampling.

d. Soil Moisture Instrument. Early laboratory testing of the soil moisture units suggested that hysteresis existed in the relationship between soil moisture and electrical resistance. A careful study made recently in soil cores confirmed this. The moisture units consistently showed a lower resistance at the same soil moisture content when the soil was wetted to reach this moisture content than when it was dried. The hysteresis loop terminated at about field capacity and wilting point.

The significance of this finding is that if a dry soil is wetted only part way (that is, not to field capacity) the resistance-indicated moisture content may be as much as 1 percent higher than the true moisture content. Results of this study are of interest primarily to students of soil physics. They do not detract from the usefulness of the fiberglas instrument because (1) 1 percent of soil moisture represents a very small quantity of water and (2) a soil layer wet by rain or irrigation is usually brought very near to field capacity moisture content.

Investigations were started to determine changes in soil moisture: moisture tension relations that may be due to: (1) the method of inserting the soil units in soil cores in relation to the diameter of

the cores, and (2) the moisture content of the soil at time of cutting, inserting the units and containing the soil cores. Undisturbed soil cores two inches and three inches in diameter and two inches in length are being tested.

e. Plant Physiology. Physiology studies of four kinds are being carried on. The following progress is reported:

(1) Nutrition Studies. In the greenhouse studies, it has been observed that some plants showed leaf burning if they were watered with a microelement solution composed of boron, copper, molybdenum, magnesium, and zinc. This has been especially noticeable in the case of Rhus ovata, and consequently this species has been used in a new study to determine which of the elements is causing the burning.

Fertilizer plots have been established in several field locations to test the results previously obtained in the greenhouse. Locations were selected on Wilson Diorite, Lowe Granodiorite, and Anorthosite formations in the Los Angeles River watershed. At each location plots were laid out in Latin square design to study the effect of fertilization with nitrogen, phosphorus, and a combination of nitrogen and phosphorus. The design included non-fertilized controls. Permission was obtained to place one set of plots on the Pasadena City Water Company property in the Arroyo Seco. The first growth studies will be made on the plots at the conclusion of the 1951 growing season.

(2) Transpiration Studies. Two Coulter pines, each about 3 feet high, have been moved from the lysimeter area at Tanbark Flat, through the fumigation system, into the Earhart Plant Research Laboratory. They were planted in fumigated lysimeter soils with two soil moisture units in each container. Once established, these trees will be used to correlate soil moisture and environmental factors with transpiration.

(3) Germination and Growth Studies. Physiological studies of grasses which are considered promising for soil stabilization work in chaparral areas are continuing. Preliminary 4-week germination tests under four different temperature regimes have been completed for 35 seed samples representing 28 species. These germination tests have confirmed earlier observations that every species has some particular optimum temperature for germination. Every grass tested germinated earliest at the higher temperatures, but for some species total germination was greater at lower temperatures.

The following sample from the data illustrates the above points:

GERMINATION PERCENTAGES

	After 2 weeks		After 4 weeks	
	17°C Day 6°C Night	30°C Day 17°C Night	17°C Day 6°C Night	30°C Day 17°C Night
Group I (Warm temp. species)				
Agropyron elongatum	24	50	51	59
Andropogon saccharoides	3	26	13	30
Lolium subulatum	38	87	69	93
Oryzopsis miliacea	0	40	35	74
Group II (Cool temp. species)				
Agropyron cristatum	7	13	26	18
Bromus marginatus	51	57	72	60
Ehrharte calycina	7	19	50	24
Stipa cernua	24	26	49	31

Photo-period and temperature studies are being made of six grass species, (Annual-- Bromus carinatus, Bromus rigidus, Bromus rubens; Perennials-- Melica imperfecta, Poa scabrella, Stipa lepida), and three shrubs (Adenostoma fasciculatum, Ceanothus crassifolius, Eriogonum fasciculatum) to evaluate better the responses of these plants to environmental conditions in the Earhart Laboratory.

Photo-periods of 24 and 8 hours are being used, and for each the following temperature regimes are being maintained:

Day	Night
Degrees C.	
30	3
20	10
20	6
20	3

Bromus carinatus is the only species to have flowered under the 24-hour photo-period three months after planting. This flowering is most advanced at the higher temperatures.

The information obtained from the study above will be used to establish criteria for screening exotic species suggested as promising for field tests in chaparral areas. In addition, a better understanding of the responses of chaparral species to temperature and photo-period will aid in selecting the season of year for fertilizer

applications and other field work of the research program.

Two genera of native plants, Arctostaphylos and Eriodictyon, have been subjected to germination tests. A method has been devised for treating the seed of Eriodictyon crassifolium which has increased germination from zero to approximately 60 percent. The method consists simply of wearing down the outer seed coats by blowing the seed with an air blast against sand-lined walls of a quart Mason jar.

(4) Watershed Cover Conversion. A pilot experiment is being carried on in two watersheds, approximately 1 acre in size, in Coon Canyon of the Arroyo Seco. The objectives of this experiment are threefold: To determine if grass remnants present are capable of occupying an area when competition from brush has been eliminated; to test grass seeding methods by broadcast sowing vs. broadcast sowing plus raking, in areas where brush has been killed by spraying; and to obtain an indication of the effect of grass cover on soil stabilization. One watershed was sprayed with a mixture of 2,4-D and 2,4,5-T in June 1950. In March 1951 a number of small plots were sown with Poa bulbosa and Lolium subulatum. Records are to be taken of growth of sown grass, grass invasion and increase in non-seeded areas, and any recovery of the brush, most of which now appears to be dead.

f. Soil Movement Survey. Retzer prepared a preliminary work plan for this survey early in March, and since then has been developing detailed procedures based on careful examinations of soil in the field. Six small watersheds in the lower part of the Los Angeles River watershed have been studied intensively, and much has been learned about kinds of soil and mass movement. Four other watersheds have been selected for study in April.

g. Root Study. Juhren and O'Keefe started the root study with trial excavations at a site near Tanbark Flat on the San Dimas Experimental Forest. Here procedures were worked out and tested before moving to less accessible sites in the Los Angeles River watershed. Using a fire suppression pumper, roots of chaparral shrubs were uncovered with little difficulty. High pressure single stream nozzles were used to follow out the larger roots, and standard spray nozzles were used to unearth feeder roots. About 3,500 gallons of water per day were used through three hose lines.

Sixteen plants were excavated at the San Dimas site in 10 days, including several plants each of Ceanothus crassifolius, Salvia mellifera and Adenostoma fasciculatum. The indications are that the species will fall into rather well-defined root types. Five sites representing various soil, rock and vegetation conditions have been selected in the Los Angeles River watershed by Hellmers and Juhren for the main study.

h. Plant Search. Through the use of reference sources, information has been compiled concerning areas of the world in which plants may be found that have possible value for erosion control and slope stabilization in southern California mountains. Primarily, this includes source material from south and southwest Australia, south Africa, central Chile and the Mediterranean region. A tentative plant list is now being compiled.

Field trips have been made to the following places: L. A. State and County Arboretum, Arcadia; the home of Mr. Lux, Cloverleaf Canyon, Monrovia; Huntington Botanic Gardens, San Marino; Theodore Payne Nursery, Glendale. These trips proved of particular value, permitting an on-the-spot analysis of the growth forms, growth requirements, and adaptability, etc., of native and exotic species. Several genera and some individual species were repeatedly encountered which show definite possibilities as erosion control plants.

i. Fire Case History. Planning of the study was resumed after its interruption by field work during the wet months of November and December. In January and February conferences were held with the Forest Service Regional Office staff in San Francisco, the State Forester, the Soil Conservation Service, and the Agricultural Extension Service, to acquaint these groups with the objectives of the study, and to arrange for their cooperation. Arrangements were made to have the Federal and State forest rangers, in districts embracing significant areas of brush, report the location of burned areas and erosion conditions as affected by burning, insofar as they could without special field work. The reports already turned in by 62 rangers constitute a universe which can be sampled for current field examination. Gleason has begun making the rounds of these ranger districts from Redding to San Diego, studying burned areas of different ages, and recording data documented in earlier years. The field phase of the job is scheduled to be completed by the end of May.

7. Meetings Attended

Between December 8, 1950 and March 17, 1951, Kraebel gave five talks about Japan on variations of the general theme of "Forests, Floods and Food" to groups of 30 to 100 people, including two men's clubs, a book club, YWCA, and the California Botanical Society, and a talk on "Forests and Water Supply in California" to an honorary educational society.

December 1. A Conservation Committee meeting of the Los Angeles Chamber of Commerce was attended by Sinclair. Chairman W. S. Rosecrans presented a statement outlining the objectives and activities of the Committee which is quoted here in part:

"The general objective of the Committee is to represent community interests in the protection of our natural resources, particularly water, but also including our recreational areas and wildlife.

"The Conservation Committee's field of activity has largely to do with the protection of our natural water supplies from rainfall and preservation of our watersheds. This Committee's operations also include the question of reclamation of sewage water.

"Watershed Management.

(a) Forest Influences

"Periodic reviews of the work and findings of the San Dimas Forest Experiment Station will be had, together with the consideration of similar work in this field at other stations.

"Particular consideration will be given to current, statewide studies on burning."

Mr. Rosecrans also showed some color photos he had taken recently in Utah. In discussing them he stressed the misuse of land, particularly overgrazing and its relation to floods in the area of the Wasatch Mountains. He spoke highly of studies made by the Forest Service, especially the terracing demonstration near Farmington.

December 12-13. Pacific Southwest Federal Inter-Agency Technical Committee and its Sedimentation Sub-Committee meetings in Los Angeles, were attended by Sinclair. Discussions concerning a proposed watershed study in the San Rafael Basin in Utah were of particular interest. This was suggested as a Federal Inter-Agency "pilot" investigation of sedimentation in the Colorado River drainage.

January 26-27. Kraebel and Colman attended the Second Regional Conservation Conference, held on the Berkeley campus, and sponsored jointly by the California Department of Natural Resources, the California Department of Education, and the University of California. The panel on soils, on which Colman served, held discussions of many problems of land management, and tried to answer numerous questions posed by an audience composed of technical and lay people. Many questions touched on the burning of brushland.

February. During this month Hellmers gave three lectures on soil organic matter to the advanced class in plant physiology at the California Institute of Technology, Pasadena.

February 8. Colman presented a talk on "Watershed Management on Wildlands" at the annual meeting of the California State Association of Soil Conservation Districts, in San Jose.

February 9. Ashby discussed the division's plant physiology research program at a meeting of the staff of the Earhart Plant Research Laboratory, Cal Tech, Pasadena. He also presented the subject of his

doctorate thesis, "The effects of certain acid growth-regulating substances and their corresponding aldehydes on the growth of roots", at the plant physiology seminar of the California Institute of Technology.

February 9-10. The annual meeting of the South Pacific Section of American Geophysical Union at Fresno was attended by Colman, Hamilton, and Rowe. Hamilton presented a paper "Rainfall Sampling on Rugged Terrain" before the Section of Meteorology, and Rowe a paper "Interception of Rain and Snow by Second-Growth Ponderosa Pine" before a joint session of the Sections of Hydrology and Meteorology.

February 14. Forest Influences problems and research activities were described at a meeting for members of the Forest Experiment Station. This was one of a series of one-hour meetings planned to acquaint all Station personnel in Berkeley with the work of all divisions. Sinclair, Kraebel, Gleason, and Colman spoke.

8. Cooperation

a. Pomona College. Rowe continued advising Willis L. Burnham, geology major, in his study of ground water in Day and Etiwanda Canyons.

b. State of California, Division of Forestry. Information on portable infiltrometers was furnished Robert H. Blanford, Redding, California.

c. University of California, Los Angeles. Meteorological data including air temperature, relative humidity, wind velocity, and barometric pressure were supplied to a group engaged in determining the audible range of fire sirens throughout Los Angeles County.

d. Mr. Harold Conkling, consulting engineer at Los Angeles, was provided with Flood Control Survey sedimentation data for the Santa Maria drainage.

e. Chaffey High School, Ontario, California. On January 22, photographs and maps were loaned for use in an exhibit for Conservation Week.

f. Citrus High School and Junior College, Glendora. On January 29 photographs and maps were loaned for an exhibit in connection with Earth Science courses.

g. National Forest Administration, Region 5. In January the Regional Office of Watershed Management, jointly with Los Padres National Forest, started a study of watershed conditions and land use in the Santa Ynez River drainage. At the request of the Regional Office Sinclair was detailed for the remainder of the fiscal year to take charge of the study.

Within the last two years oil discoveries have been made and new oil fields developed just north of the Santa Ynez watershed, in the Cuyama Valley. More recently numerous applications have been filed for exploration permits within the Santa Ynez. Exploration and development of oil fields within the watershed could endanger the water crop, for the protection of which the National Forest was established. In the present investigation the yield, quality, use, and value of Santa Ynez river water is being studied, as well as the effects upon watershed conditions of activities attendant upon oil exploration and development. Recommendations will be made for permissible land use and resource development in various parts of the watershed.

h. In December, as a member of the formal review board, Kraebel reviewed a manuscript by L. R. Rich, of the Southwestern Station, tentatively titled "Water Yields, Sediment Production and Vegetation Conditions of Granitic Watershed Areas of Central Arizona".

i. Hawaii. In response to a request from Associate Territorial Forester L. W. Bryan of Hilo, small quantities of seed of a number of California conifers and hardwood trees and shrubs were sent him. The seed is being used in continuation of planting tests of exotics at various elevations on Hawaii's big mountains, begun over 40 years ago by Ralph Hosmer, added to by C. S. Judd and Kraebel, and greatly extended during the past 25 years by Col. Bryan.

j. U. S. Navy. Kraebel made a field examination and recommended a plan for erosion control on a 300-acre hillside "fuel-tank farm" in the San Francisco Bay area. Soils of the tract had been literally turned upside down ten years ago during construction of large underground fuel reservoirs. A revegetation plan for camouflage and soil stabilization of the area, recommended in 1943 by a committee of which Kraebel was a member, had been only partially carried out. During the past "wet" winter, erosion in the area reached serious proportions, caused largely by poor drainage and lack of stabilization of service roads in the area. New gullies, cut into slopes below culverts, are now so large that check-dams and willow planting will be needed to control them and prevent their excavating some of the subterranean tanks.

k. Radio. On February 27, Kraebel participated with Talbot and Cornelius (Range Research Division) in making tape recordings on some aspects of conservation of natural resources, for use by the McClatchy Broadcasting Company of Sacramento in a series of broadcasts over Central Valley radio stations. Kraebel's interview defined forest influences research in terms of its ultimate objective of good watershed management, described some activities that damage watersheds and the water crop, and outlined methods of preventing or repairing such damages.

l. Public. Samples from the "inquiry correspondence" handled by Kraebel:

Advice was given by letter to rancher F. H. Miller of southern California regarding development and protection of a spring on his place.

Suggestions for tree planting on a hill ranch in Napa County were furnished by letter to H. J. Morris.

Some "do's and don'ts" for a proposed Christmas tree planting project in the Sierra foothills were sent to rancher P. Visel of Mariposa.

A letter reply was sent to the National Park Service regarding use of water by riparian vegetation in Death Valley.

m. City of Glendora. Rowe has been invited to become a member of the Water Committee. This group includes three members each from the Glendora Irrigating Company, Glendora Independent Water Company, and the City Planning Commission, including the Mayor. One of the aims of this committee is to develop a coordinated water use and conservation plan for the Glendora Basin. At a recent meeting Rowe discussed annual rainfall trends in relation to local water supply during drought periods.

n. University of California. Professor H. Earl Storie of the Division of Soils, University of California, met with Colman and Rowe at Glendora to discuss the possibility of Rowe's assisting in a soils report to be prepared by Storie and others and to be published by the University. This report is to be based upon data collected during the Mendocino County vegetation-soils survey, in which the Station participated. Rowe will assist in the development of survey legends showing the hydrologic characteristics of the soils mapped and in the preparation of a section of the report illustrating the application of this information in land and watershed management.

o. Los Angeles City Department of Water and Power. Stanley A. Wilfong and E. H. Graham of the Department of Water and Power, City of Los Angeles, and William W. Donnan of the Soil Conservation Service, conferred with Rowe on various phases of their study of safe water yield in the San Fernando Valley.

9. Visitors

December 1. Dr. Ed Phillips and 10 students from Pomona College were guided over the San Dimas by Horton.

December 5. Mr. M. C. Bechtolshim of Redlands, California, visited the San Dimas to discuss erosion control problems with Rowe.

December 7. Nine students from Dr. J. Bonner's physiology class at Cal Tech were guided over the San Dimas by Hellmers and Horton.

December 11. E. B. Georgoulis, forester from the Greek National forestry headquarters in Athens visited Kraebel and Colman for discussions of watershed damage resulting from overgrazing and fire, and of methods of erosion control and revegetation.

December 13. Professor Albert Ulrich from Cal Tech and H. K. Trobitz were taken to Tanbark Flat by Horton.

December 14. G. W. Craddock, Intermountain Station, Ogden, Utah, spent one day on the San Dimas Experimental Forest. He visited both Tanbark Flat and the physiology project at Cal Tech.

December 16-17. Fifteen members of the Conservation Committee of American Legion Post 13 at Pasadena spent the weekend on the San Dimas Forest. Guests of the group on Saturday included Drs. Bonner, Jahns, and Sharp of Cal Tech.

December 16. Dr. J. K. Taylor, in charge of soils research for the Commonwealth Government of Australia, visited the San Dimas Forest, guided by Hamilton.

December 31. Dr. W. C. Lowdermilk and party made a brief visit to the Experimental Forest.

January 4. Mr. Masahiko Honjo, Engineer Secretary, Economic Stabilization Board, Tokyo, Japan, was shown over the Experimental Forest by Hamilton.

January 9. Fred Strauss, successor to Fred Paget, in charge of the State Snow Survey in California discussed snow survey organization and problems, and needs of snow research with Kraebel.

January 15. Colin Marshall, forester from Fiji visited the Berkeley office for discussions of forestry, water and erosion problems in the Pacific area.

January 31-February 1. Mr. R. G. Snider, Vice President of the Conservation Foundation of New York visited the Station's plant physiology project at Cal Tech. He appeared extremely interested in the current research being carried on there. Following his visit at Cal Tech Mr. Snider was shown over the Experimental Forest by Hamilton.

February 3, 4, and 5. Regional Forester Clare W. Hendee spent the weekend at the Tanbark Flat Field Headquarters. He was given an outline of the research program and was shown the experimental installations by Hamilton.

February 6. Dr. C. H. Muller of the University of California at Santa Barbara visited the plant physiology project. Several hours were spent in a stimulating discussion of the proposed root study project. Dr. Muller offered several suggestions based on his experience on the Guayule Project, where he investigated root development of guayule under cultivated and natural conditions.

February 13. Dr. R. L. Crocker of the Division of Soils, University of California at Berkeley, spent one day observing the soils and geology of the Angeles River Basin. Accompanying him were C. Young and J. Fisher of the Arcadia Soils Laboratory, Hellmers, and Ashby. Crocker pointed out that in poor soil areas in Australia grass cover could be maintained only if legumes were included in the stand.

March 21. Clint Davis, Director of Cooperative Forest Fire Prevention Program, accompanied by Henry Wehde, Council Executive from the New York office of the Advertising Council, and E. F. Grant, Jr., from Los Angeles, visited the San Dimas Experimental Forest. Mrs. Wehde accompanied the party. Hamilton discussed highlights of watershed management research in order to acquaint Mr. Wehde with the relation between forests, water and reservoir problems in this region.

QUARTERLY REPORT OF FLOOD CONTROL SURVEY ACTIVITIES

California Forest and Range Experiment Station

December 1, 1950 - March 31, 1951

General

Early in February Ilch was detailed to the Washington Office to assist in the review and revision of five southern California survey reports which were under consideration. Each of the reports was reviewed by the Forest Service Review Committee, the Bureau of Agricultural Economics, Production and Marketing Administration, and Extension Service at the Washington level. On the basis of these reviews and the comments submitted by each agency, major revisions developed in allbut one of the five reports. As a result of the policies and procedures formulated by the Department in the conduct of flood control surveys, it now appears that there is little opportunity to recommend feasible measures for reducing sediment and floodwater damage in the mountain portions of the watersheds of California where existing and authorized structures of other agencies will provide protection for the immediate future.

Local Floods

The bimonthly report for October-November included detailed information on the fall floods in central California and western Nevada. Final compilation shows that many streams had the highest flood peaks of record. The total damage in California was $31,526,000 and in western Nevada was $4,361,000. Field investigations were made to estimate the effects of watershed conditions by the Divisions of Forest Influences and Flood Control Surveys. Estimates of damage to national forest improvements were made by the Regional Office and Forest personnel. From these sources the Division of Flood Control Surveys prepared a special report on the central California floods.

Current Surveys

1. Wrightwood Area.--The report is being considered by the Board of Supervisors, San Bernardino County.

2. Santa Maria River.--Re-estimations were made of the capacity of the Santa Maria River channel to carry future floods, both with and without intensification of USDA programs in the watershed. These estimates indicated a possibility of future improvement with the USDA program. The revised report was sent to Washington in March for submission to the Secretary's Office. All reviews by Department of Agriculture agencies at the Washington level were completed.

3. San Gabriel and Santa Ana Rivers.--Further revision of these two reports is again under way as a result of local reviews by the Corps of Engineers, State Engineer, and the County Flood Control District. As a result of their comments it appears that existing or authorized structures of both the Corps

and the County will provide adequate flood protection to downstream developments for the immediate future. Although sedimentation from the watersheds above these structures is continuing at an accelerated rate both the Corps and the County have pointed out that provision for storing or handling the annual accumulation is at present satisfactory for the designed life of these structures.

In light of these comments these two reports will be combined and submitted as a single interim report, recommending only certain measures on the agricultural lands below the existing and authorized flood control improvements and not within their sphere of protection. Sufficient physical, economic, and engineering data are not available at this time to permit development of a feasible watershed treatment program above existing and authorized structures of other agencies.

4. Santa Clara-Ventura Rivers and Calleguas Creek.--Review of preliminary draft of this report by the Washington Office of the Bureau of Agricultural Economics has made it necessary to discard the basic assumptions used for evaluation of sediment damage reductions. In light of current instructions from the Secretary's Office reanalysis of the present program considered for this group of watersheds indicates that a modified program may be recommended. The modified program, in all probability, will be limited to farmland treatment measures and range and pasture improvements, both of which produce high on-site benefits. Intensified fire control for these watersheds does not now appear to be feasible under present evaluation procedures. This report is being revised and will again be submitted before the end of the fiscal year.

5. San Diego County Western Watersheds.--Again, on the basis of review by the Bureau of Agricultural Economics, this report will be revised to conform with current instructions and procedures for program evaluation.

This group of ten watersheds, located in the extreme southwestern part of California, at one time furnished the sole domestic and agricultural water supplies to the developed coastal plains and river valleys. This local water resource, now far inadequate to support population and industrial pressures, has been supplemented by importations from the Colorado River. Fifteen major reservoirs have been built to supply domestic and municipal needs first, with surface irrigation, underground replenishment, and flood as secondary functions. Twelve are surface storage reservoirs and three are off-channel structures filled by diversion conduits. The surface storage reservoirs had a combined total capacity when constructed of 741,600 acre-feet. Total storage lost since construction amounts to about 35,000 acre-feet, or a little less than 5 percent of the original capacity. As of 1946, these reservoirs had a combined average life of about 435 years, ranging from 140 years for Morena to more than 900 years for San Vicente.

With the proposed watershed treatment program, the average life of these reservoirs could be extended to about 1700 years.

Using prescribed methods for evaluating reservoir sedimentation, the total average annual discounted benefit would be about $6,500 (1948 prices), or

$4,550 when adjusted by the normal price index.

Similarly, discounting of the range improvement benefits, results in an average annual equivalent value of $314,600 (1948 prices) which is further reduced by the normal price index to about $170,000 annually.
In summary, the total annual costs and benefits now compare as follows:

Total average annual adjusted costs	$625,000
Total average annual adjusted benefits	501,000
Benefit-cost ratio	.77 to 1.0

6. Salinas River.--The Salinas River flood control survey is the primary responsibility of the Soil Conservation Service. The report was reviewed and comments forwarded to the Soil Conservation Service at Portland.

A member of the Flood Control Survey Group assisted the Soil Conservation Service in conducting a two-day field trip over the watershed for the California State Review Committee.

7. Pajaro River.--This is also a Soil Conservation Service report. A forestry program consisting of intensified fire protection for the burnable area and a conifer planting program for nonreproducing burns and cut-overs is in preparation.

Estimation of the effect of grass and chaparral fires on peak discharges and sediment production for tributaries of the Pajaro River were made. Peak discharges from burned watersheds were plotted, "double-mass," against two types of controls: (1) Meteorological controls involving maximum 24-hour precipitation and antecedent precipitation to the storms which produced peaks and (2) watershed controls involving the use of nearby unburned watersheds. Burns in grass types produced about one-half as great increases in peak discharges as did burns in chaparral types. The first three years after a burn in grass the fires produced nearly the same increase in peaks as did the chaparral fires, but recovery was rapid, so that no effects were detected by the double-mass methods after the fourth year. The effects of chaparral fires were evident even after 12 years.

8. Columbia River Basin Survey.--Mr. N. J. Penick, who is in charge of PWI preparation in Region 6, held a training session for team members in Portland the week of January 1-5. The following week, all team members, and a large number of others, assisted in or observed the preparation of a PWI program on the Mt. Hood National Forest. During the period January through March a member of the California Flood Control Group assisted in the preparation of PWI programs on the Mt. Hood, Rogue River, Siskiyou, Umpqua, Willamette, Gifford Pinchot, Siuslaw, and Fremont National Forests--a week being spent on each forest.

The "first level" compilation of land ownership and classification by counties has been completed.

(a) Willamette River.--The effects of forest cover on peak discharges which have been obtained by regression and covariance analysis were checked by using a completely different method. The double-mass method suggested by Linsley, Kohler and Paulhus ("Applied Hydrology." McGraw-Hill, New York, 1949, pp. 435 and 219) was

employed. Tests were made for two watersheds for which cover changes have been drastic--the Mollala near Canby, Oregon, and the Mohawk River near Springfield, Oregon. The results indicated that peak discharges had increased during the period of discharge records by 21 and 42 percent for the two watersheds. The results are similar to those from the regression analyses. Double-mass testing of annual yields of stream flow indicated no detectable differences in these same watersheds for the same periods.

Engineering office studies were made of possible flood-retarding reservoirs on Mohawk River, Thomas Creek, and Crabtree Creek. These studies include preliminary layout, design, and cost estimates for dams, area-capacity determinations for reservoirs, and routing of floods through the reservoirs.

Overflow areas were determined for Thomas and Crabtree Creeks. The process involves calculating capacity at channel cross sections previously surveyed and determination of area that will be flooded by various sized floods as estimated from aerial photographs and topographic maps.

b. Rogue and Umpqua Rivers.--In connection with the suspended sediment sampling in these watersheds, arrangements have been made with the national forest cooperators who are taking the samples to take a few "surface" suspended samples at the same time as the "depth-integrated" samples are taken. This will permit direct comparison of present-day sediment production with some results of sediment sampling done in 1910-14.

C E N T R A L S T A T E S F O R E S T E X P E R I M E N T S T A T I O N

Quarterly Report
of
Flood Control Surveys and Forest Influences Activity
December 1950 - March 1951

FLOOD CONTROL SURVEY ACTIVITY

General

Survey activity, hampered during December by lack of funds for SCS surveys, approached the norm in January when funds again became available for these surveys.

Our survey procedures were reexamined to determine what can be done to answer satisfactorily certain questions raised by W.O. National Forest Administration during its review of recent survey reports. As much of the information requested by NFA can be obtained only by increasing survey costs, there is little we can do to remedy this situation unless additional funds are provided for the purpose.

Cuyahoga (Ohio)--SCS

Schmitt and SCS representatives resumed field work in the sample watersheds selected for program development. Compilations by hydrologic condition classes and factors causing undesirable conditions were started.

East Fork of White-Patoka (Ind.)--SCS

Review comments concerning the survey report were received from the Washington Office. The report is now being revised to bring it in line with the W.O. comments.

Kentucky (Ky.)--SCS

Report write-up on Forest Service program is underway and on-site benefit calculations have been started.

Licking (Ky.)--SCS

Program development is about 90 percent complete and a start has been made on the cost estimates.

Red River of the North (Minn., N. Dak., S. Dak.)--SCS

Survey work outline, prepared jointly by SCS and the station, was submitted by SCS to Washington for Bureau approvals.

Scioto (Ohio)--SCS

Latest information is that the survey report is undergoing review in the various Departments who are FIARBC members.

Upper Mississippi (Ill.,Ind.,Iowa,Mich.,Minn.,Mo.,Wisc.,S.Dak.)--SCS

Survey report is being revised to conform with W.O. comments.

FOREST INFLUENCES ACTIVITY

Buckeye Research Center

General

This is the first report from the Buckeye Branch of the CSFES. Influences research began here on July 1, 1948. At that time two offices and a laboratory were made available through the courtesy of Ohio University which is located at Athens, Ohio. Since that time, the offices have been furnished; the laboratory equipped with apparatus and supplied with the materials for research; a problem analysis drafted; and several problems have received attention. This report mentions the work pursued during the past two years as well as current activities.

Research

a. Completed and published

Technical paper #112, CSFES. The paper describes a simple soil sampler and its use as a permeameter. The soil sampler is a tool of low cost and ready employment. The thought underlying its development was to make sampling of soil easier, more rapid and less expensive. The sampler has been found well adapted for measurements of volume-weight, infiltration and permeability rates, root concentrations and weights. The sampler is also expected to be useful in obtaining samples of soil atmosphere.

b. Completed and accepted for publication

(1) "Stand density as a factor in estimating white oak site index." (J. Forestry) This manuscript describes variation in the height growth of white oak with changes in stand density. The report, as it will be published, bears on influences research only as transpiration, root development, etc., may be related to site quality.

(2) "The concentration of roots in the white oak forest of southeastern Ohio." (CSFES Tech. paper) The weight of roots 1/4" or less in diameter is (on the average) 7.8, 3.2, 1.8, and 1.4 tons per acre foot in the A_1, A_2, first, and second subsoil

horizons. The first three feet of an average profile contain about 7.4 tons of these smaller roots. The concentration of small roots is at a minimum beneath the edge of tree crowns in all horizons. Where the concentration of roots is high in the A_2 horizons, the concentration of roots in other horizons will be high. Root concentrations are nearly constant after white oak stands (of the kind examined) reach the age of 30 years. Neither site quality, topography, nor stand and herbaceous cover density perceptibly affect root concentrations. Root concentrations are correlated with the permanent wilting percentage in A_2 horizons and it is possible that soil porosity, texture, and other factors have some effect on root concentrations. The above-ground growth of the bole of white oak trees does not bear a perceptible relation to the concentration of smaller roots. This study provides a background for planned studies of transpiration.

c. Completed but undergoing review

(1) "A problem analysis for forest influences research at the Buckeye Branch, CSFES."

(2) "The effect of certain soil properties and the influence of hardwood forests upon the movement and storage of water in some soils of southeastern Ohio." A summary of this work will be given at a later date. The subjects covered are infiltration, permeability, percolation, and water storage in the forest soils of southeastern Ohio.

(3) "Relation between topography, soil characteristics, and the site index of white oak in southeastern Ohio." Exposure, position on-slope, and A horizon depth significantly affect the growth of white oak. Subsoil properties and the inclination of the land do not perceptibly influence the growth of white oak. This taken in conjunction with root studies is expected to aid planned research on transpiration.

d. Current studies

Present efforts are being directed toward developing simple, inexpensive, and readily used devices for measuring lateral flow of water along soil horizon interfaces. In addition, methods for determining the location of decayed root systems are being sought.

e. Proposed studies

To date, all research has been of the reconnaissance type. As the selection of an experimental forest is yet to be made, it is expected that more reconnaissance work will be undertaken. Three projects are being planned for the coming field season:

(1) Soil atmosphere. The role of tree roots in promoting percolation has been found interesting. Therefore studies of soil aeration and other factors limiting root development will be undertaken and possibly completed this year.

(2) Growth of red, white, and shortleaf pines. A study may be made to find and evaluate the near permanent features of the site affecting the growth of these species. Such a study would serve as a precursor for studies falling directly into the field of forest influences.

(3) Transpiration and evaporation. If protected experimental areas become available, a plan to measure, individually, transpiration and evaporation in undisturbed forest stands can be put into effect.

Miscellany

The Buckeye Branch, CSFES, organized a field trip for members of the forest soils subsection of the Soil Science Society of America following the Cincinnati meeting (October-November, 1950).

QUARTERLY REPORT OF FOREST INFLUENCES DIVISION

Intermountain Forest and Range Experiment Station

January, February, and March, 1951

Activities of this division during the past quarter mainly involved writing and planning. Reports on several studies were developed to the manuscript stage, analyses were virtually completed on others, and plans were outlined for new efforts.

Great Basin

The main effort at this center was to complete the analysis of the A and B watershed data, including the records of precipitation, runoff, and erosion during 1950. This work has reached the final stage and during the coming spring quarter, it is planned to review the highlights of the findings and block out an outline for a comprehensive report on this long-range study covering the period 1916-1950, inclusive.

Two new low precipitation records were recorded in the Ephraim Creek area during the past winter. These included a monthly total precipitation of only .08 inch at Sorensons Field Station, elevation 5,580, as compared to a long-time average of 1.02 inches; and a record of only .47 inch at the Meadows Station, elevation 9,860 feet, as compared to a long-time average of 2.59. Precipitation was also very low at Oaks Station, elevation 7,655 and at Headquarters Station, elevation 8,850 feet.

Notwithstanding the exceptionally low October precipitation records at all stations, rain and snow during the remainder of the winter brought the winter total up to about 15 percent of normal. It is expected that Ephraim Creek runoff during the coming year will be from 80 to 90 percent of normal.

A progress report was completed of an exploratory infiltrometer study made in a part of the Colorado River basin during the summer of 1950. This study was made at the Buckhorn Flat about 15 miles east of Castle Dale, Utah on desert grass-shrub range representative of some of the high sediment yielding lands of the Colorado River basin. A total of 26 sites was tested, some inside a livestock exclosure and some on currently grazed range. The sites had very small amounts of plant and litter cover, ranging from 31 percent inside the exclosure to about 16 percent on the grazed range. Infiltration, runoff, and sediment production were found to be affected mainly by soil characteristics, sites with sandy loam soils having higher infiltration capacities than those with clay loam soil. Infiltration capacities were found to average about .50 inch greater on dry sites than after wetting. By contrast, more sediment was eroded during the dry soil runs than during the wet soil tests.

Further study will be necessary to determine the reasons for these differences in behavior and also to more fully isolate and evaluate the specific effects of plant cover.

Wasatch Front

Major effort at this station has been devoted to the development of reports on an evapo-transpiration study and a surface runoff and erosion study. Both have reached manuscript stage and should be ready for publication in the near future.

The evapo-transpiration study is based mainly on a 3-year record of soil moisture on normal aspen sites, sites on which aspen only was removed, and sites on which all vegetation was removed. The study has revealed that on aspen sites about 3.5 inches less water is available for stream flow than from sites having only herbaceous plant cover, the difference being due mainly to greater extraction of soil moisture in the 4- to 6-foot soil horizons by the deep-rooted aspen.

The surface runoff study is based upon records of 1/40- and 1/10-acre plots in the headwaters of the Parrish Creek Watershed. Some of these plots were established on well covered, nonflood-source sites, some of which have since been denuded. Others were established on sparsely covered, flood-source sites, some of which have been kept in a depleted condition, whereas others have been improved by both natural and artificial revegetation. The plots have been subjected to 138 summer storms since 1936, involving a total of 43.68 inches. The records show conclusively that depletion of plant cover changes a nonflood-source and noneroding site to a flood and sediment source; and that flood-source areas can be restored to a nonflood and noneroding condition by either natural or artificial revegetation. Runoff of less than 5 percent per storm appears to be essential for preventing excessive erosion. To achieve this degree of control during high intensity rains, at least 65 percent of the ground surface must be covered by living plants or litter. This "protection" requirement is essentially the same as that which has been found necessary for runoff control and soil stability on grass range with loose, granitic soils in Idaho and heavy, clay rocks on subalpine herbaceous range in central Utah.

The Wasatch Experimental Watersheds have continued to be a focal point of interest for conservationists. The most recent visitors included a group of 50 Region-4 rangers on a training tour, 12 members of the Armour Company tour, 5 members of the State Foresters, and members of the Pacific Southwest Federal Interagency Sedimentation Subcommittee.

In the late summer and early fall of 1950 the Manti-LaSal National Forest did considerable watershed improvement work in Dry Pole Fork drainage of the Mt. Pleasant Watershed, near Mt. Pleasant, Utah. Influences personnel from the Wasatch and Great Basin Stations

assisted in laying out this work. Dry Pole Fork is one of the main flood-source areas in the Mt. Pleasant Watershed, from which numerous destructive floods have issued. The headwaters slopes of this drainage now have a plant cover that is woefully inadequate for watershed protection. Competition from herbaceous sage and other plants would have been too keen for successful reseeding. Accordingly, the present cover was reduced by double disking with a Gobel disk drawn by a D-7 caterpillar tractor. Practically the entire watershed was then contour-trenched and reseeded with selected grass species. With the competition diminished and with the surprisingly deep soil still remaining on most of the watershed, an excellent stand of grass should be obtained within a year or two. National Forest Administration plans to extend this treatment to other flood-source areas in the Mt. Pleasant Watershed in 1951. There are high hopes that the treatment here will be as effective as that on the Davis County Watershed in northern Utah.

During the past winter, a battery of Coleman soil moisture meters was laboratory calibrated. These meters are to be installed in the field during the coming season as part of a study of the water losses on good and depleted herbaceous range.

Boise River

A report on snow accumulations and melting in ponderosa pine was completed and submitted for publication in the Journal of Forestry. This paper reports the results of a follow-up study to one conducted by C. A. Connaughton in the early thirties and includes the effects of slope aspect as well as cover conditions on the accumulation and retention of snow.

A progress report was completed on the status of studies to date on the watershed protection requirements of foothill grass ranges having loose, granitic soil. Requirements for minimizing erosion during summer rains on undisturbed wheatgrass and cheatgrass range appear to be a total ground cover of about 70 percent with no bare soil openings larger than 4 inches in diameter. The 70-percent ground cover value is comparable to a 35- to 40-percent forage density as visualized by range survey concepts. The report includes some data on the effects of trampling disturbance and of very high rainfall intensities and lists further studies needed for determining the extent to which the spring-fall range may be utilized without accelerating erosion.

A problem analysis of the Boise province was developed to the final stage of selecting a program of studies in keeping with available funds and manpower. As part of this effort, 27 range watersheds of from 40 to 200 acres in size were examined for possible experimental purposes. In addition, 91 subbasins within the Boise Basin Experimental Forest were examined for possible use in a logging-sedimentation study. Pending the feasibility of carrying out these entire watershed studies, the program for the immediate future will

continue to be devoted to plot studies of criteria for watershed protection and of methods for reestablishing an effective plant cover on depleted and eroded range.

How to reestablish an effective soil stabilizing plant cover on the steep, south aspects of the spring-fall range on the Boise, Payette, and Salmon Rivers Watersheds has long been a problem. Reseeding has repeatedly failed, apparently due to a soil moisture deficiency in the upper soil profile following seedling development in the spring. A further effort on this problem was initiated last fall in cooperation with the Artificial Reseeding Division. In this study, a group of 5 promising species was sowed on sites with varying degrees of competition for moisture. The study was designed to include mulching and watering during the growing season. This spring and summer it is planned to check seedling mortality and root development in relation to the recession of available moisture in the soil profile. This study should show conclusively whether soil moisture is a major limiting factor and may indicate which species and cultural treatment for competition control are essential for plant cover establishment.

QUARTERLY REPORT OF FLOOD CONTROL SURVEY ACTIVITIES

Intermountain Forest and Range Experiment Station

January, February, and March, 1951

Columbia Basin

During this quarter the larger part of Flood Control Survey activities were devoted to the Columbia River basin comprehensive survey. Activities were about equally divided between matters of specific concern to flood control and assistance to the Region in getting the revision of the Project Work Inventory under way on all of the national forest lands of the basin. Members of the FCS staff first assisted Region 4 in preparing standards to be used in PWI compilation. During the last week of January most of the staff took part in a week-long training meeting for personnel assigned to supervise the PWI revision at the forest level. This was followed in February by a series of meetings conducted on each forest. These meetings were conducted by a 2-man team made up of a representative of National Forest Administration and FCS. At the field meetings which were participated in by forest supervisors, forest office staff men, and rangers, there was opportunity to thoroughly explain and discuss flood control objectives and the relationship of various PWI items to flood control needs. The field meetings also afforded the FCS men an opportunity to obtain supplemental data from forest offices which will be needed in preparing the flood control portion of the Comprehensive Agricultural Program report. It appears that these on-the-ground meetings will enable the forest to very soon compile a list of total needs on each forest. In fact, some forests have already submitted a tentative summary of program needs. During early January the FCS staff prepared a brochure which included more detailed explanation of standards for PWI measures related to flood control. It also included brief comments and descriptive photographs of remedial measures to be considered. Copies of this brochure were used on each forest during the PWI meetings and materially assisted forest personnel in compiling estimates of flood control needs.

Preliminary areal data for the States of Idaho, Oregon, Utah, and Nevada were completed. Engineering, Land Use, and Drafting devoted considerable time to the mapping and compilation of forest and range by ownership in our portion of the basin. This became a rather time-consuming job since it was necessary to overlay type maps on ownership maps and planimeter forest and range types by ownership. This particular job for the area of our responsibility was assigned to FCS by the CAP Field Committee. At the end of the period it was completed to the stage of final checking with NFA, the State of Idaho, and other Federal agencies.

Arrangements were completed with the Soil Conservation Service on the division of responsibility for the collection of road, highway, and sediment damages in the Intermountain area. Preliminary information on damages occurring on national forest lands were collected by Survey personnel during the PWI meetings. Contacts were made with the Corps of Engineers regarding the availability of unpublished damage data. While that agency has a considerable amount of such information, it is in rough form and we found that additional work by Corps of Engineers personnel would be required before it could be released for our use. The Corps desires reimbursement for such work and the amount involved is beyond our available funds for fiscal year. It will therefore be necessary for us to postpone any further consideration of obtaining this data during fiscal year 1951 with the hope that next year's allotment will provide enough leeway so that we can contract for the completion of at least the most important sections.

The CAP Field Committee assigned Flood Control the job of preparing preliminary drafts of much of the section of the report dealing with "Area Characteristics." Included are narrative description and some tabular data on: physiography, geology, soils, climate, water yields, erosion, and sedimentation. A total of approximately 2½ months has been devoted to this assignment which has a due date of May 1 and at the end of the quarter first drafts were nearing completion but will require review by other Station personnel and Region 4.

Other assignments for preparation of Section II, "Area Characteristics," and Section III, "Problems and Goals," of the CAP report were announced by the Field Committee late in January. These assignments involved joint participation by Region 4 and Station personnel. After a number of meetings and conferences assignments were given to individual members of the Region 4 Regional office and the Station for subportions of the main assignment. The various jobs are progressing reasonably well though slightly behind schedule.

Some progress was made in further analysis of the snow data for 1950 and the major job of processing stream flow and climatic data on sample watersheds was gotten under way.

Boise River

Following Washington Office review of the Boise report in December and efforts to meet the questions raised last fall by the Secretary's Office, about 20 man-days were devoted to additional and supplemental analysis of hydrologic and sedimentation phases of this report. On February 26 Blanch was detailed to Washington to assist in the further revision of this report in accordance with instructions from the Secretary's Office. This detail had not been completed at the end of the quarter.

Sevier Lake

Late in calendar year 1950 the Department received comments on the Sevier report from the Corps of Engineers and the Department of Interior. These comments required the compilation and analysis of additional information on flood reduction, infiltration, and computation of future damages. The information so obtained was presented in the form of a reply to the comments received and forwarded to Washington during the quarter. Recent information indicates that this material will provide satisfactory answer to the comments raised, some of which will need to be included as revisions in the final draft of the report. This particular job involved quite a lot of time in the form of statistical analysis of stream flow records in order to present more definite conclusions concerning the probable effect of the recommended USDA program on water yield. Since runoff records in the watershed were not considered adequate to measure the effects of past use, long-time records on small streams in Salt Lake County were also studied to obtain additional information. A preliminary report on these analyses was completed.

Fountain River

This report was revised during the quarter in accordance with information from Washington pertaining to evaluation procedure and was submitted to Washington in mid-March. At the same time copies were recirculated to the SCS, Paul Swarthout, Southern Station, Region 2, and Rocky Mountain Station. In answer to specific requests, copies were also forwarded to the Corps of Engineers, Albuquerque District, and to the Post Engineer, Camp Carson. This particular revision consisted largely of adjusting damages and benefits to reflect net values and the discounting of future damages and benefits to present worth. Other minor changes were also made as a result of comments submitted by other agencies following a review of the previous draft. Information received during the quarter indicates that still further revision will be required as a result of further questions raised by the Bureau of Agricultural Economics pertaining to the evaluation of reservoir damages and the adjustments of costs and benefits to the future average prices.

AWR (Arkansas above Pueblo)

Maps and aerial mosaics for the area above Pueblo were ordered and received. A preliminary summary of cover and land ownership was completed. The county areas for our portion of the basin were determined and correlated with the SCS in Albuquerque. A survey work outline for flood control activities in the area above Pueblo was completed and submitted to the SCS and Washington Office for review and approval. Lobenstein participated in a meeting at Denver on December 16, called by the AWR Field Committee, at which there were representatives of the Corps of

Engineers, Department of Interior agencies, State of Colorado, Soil Conservation Service, and the Forest Service. The purpose of the meeting was that of preliminary discussion between the agencies involved of flood control and drainage problems. One of the results of this meeting was a request from the Corps of Engineers, Albuquerque District, for a subsequent meeting with our Survey staff to discuss and explore the possibilities of joint approach to a number of the flood control problems, especially on tributary streams in the area above Pueblo. Such a meeting is now scheduled for mid-April. In proposing this get-together the Corps of Engineers representatives informally indicated a desire to recognize the possible effects of USDA program of land treatment measures on peak flows and sediment production and to consider these probable effects in designing flood control projects.

Colorado River

Little time was available for work on the Colorado River. However, the first draft of the FCS problem analysis and appendix material was completed by committee and is awaiting review by other sections of the Flood Control staff. An outline of a proposed San Rafael River erosion survey was completed and submitted to A. R. Croft for review. A map showing the sedimentation source areas of the San Rafael Basin prepared by Eldon Thorpe was received from the SCS and reviewed by Adams and Croft. The map will be returned to the SCS, Albuquerque, for completion of the write-up by Thorpe. This is a follow-up on Thorpe's assignment to the San Rafael Basin last spring and also the field studies made last summer by Adams and Croft.

Several days were spent by Rosa and Adams in the preparation of recommendations for an extensive but badly needed series of sediment stations in the Colorado Basin.

Virgin River

The preliminary draft of the survey report and appendix was completed during the quarter. Economic evaluation procedures utilized followed instructions in effect during the quarter, but we have since been informed that further changes in economic evaluation procedures are in the offing and therefore processing of the report is being held up pending further information and instructions.

Infiltration and erosion data obtained during this survey were combined with similar information obtained on other watersheds and assembled into a preliminary paper dealing with the infiltration and erosion relationships of the browse-shrub type. This material was prepared primarily for use in a recent seminar discussion but was also furnished to Region 4 to assist in their consideration of reseeding standards for this type.

Wasatch Front

Suggestions, mostly of a minor nature, were received from the Washington Office late in last calendar year. The necessary changes were made in the report and the report and appendix were reproduced during the quarter. Copies were forwarded for review and comment to the Washington Office, Soil Conservation Service, Warren Murphy, Agricultural Extension Service, Production Marketing Administration, and field offices of the FIARBC agencies.

Assistance to the SCS

Approximately 5 man-days of time were spent assisting the SCS in a review of their latest draft on the Pecos River survey report and a review of forest conservation benefits for the Middle Rio Grande watershed.

General

In addition to the time already indicated as devoted to PWI revision in the Columbia River basin, approximately 30 man-days of time were contributed by Survey staff members to the PWI revision in other portions of Region 4. The Region's PWI revision program was conducted not only in the Columbia River basin but throughout the Region and FCS participated on all forests in the Region. More complete and reliable data on flood control needs in unsurveyed portions of the Colorado River basin and the Great Basin will thus be available when needed. This compilation of program needs on national forest lands will also provide a check on program recommendations included in the Sevier Lake, Virgin River, and Wasatch Front survey reports.

Lobenstein took part in a meeting at Missoula in late March called by James Farrell, Forest Service representative of the Field Committee, and attended by Regions 1, 4, and 6 and Intermountain, Northern Rocky Mountain, and Pacific Northwest Stations. The primary purpose of the meeting was to obtain uniform understanding and agreement upon procedure and plans for the preparation of the "Area Characteristics" and "Problems and Goals," sections of the CAP report.

Murray prepared a paper on "The Applicability of Infiltration Data to Watersheds," which he delivered as discussion leader at the Station seminar on March 8.

A manuscript prepared in 1949 by Rosa and Tigerman on "Methods on Relating Sediment Production to Watershed Conditions," is nearing completion and Station clearance for publication as a Station research paper.

First drafts were completed on three additional papers by Rosa and Tigerman on "Water Yield in Relation to Use on Small Watersheds," "Runoff Trends in the Sevier Watersheds," and "Observation of Infiltration and Erosion Characteristics on Browse-shrub Cover in the Intermountain West."

Northeastern Forest Experiment Station

Upper Darby, Pa.

QUARTERLY REPORT ON

FOREST INFLUENCES AND FLOOD CONTROL SURVEYS

April 1, 1951

FOREST INFLUENCES

GENERAL

by H. C. Storey

During the past quarter a Division of Forest Influences was established at this Station. Storey was appointed chief of it.

With the increasing recognition of the importance of watershed management to the Northeast the need for forest-influences research has become more and more evident. In response to this need, the Station has undertaken a number of influences-research projects at several of the research centers. Establishment of the new division will insure the proper correlation of influences-research projects, will assist in making research results currently available, and will assist in starting new projects as needed.

It is felt that the Station's research program has been greatly strengthened, and the Station is now better able to supply the research needs of the region.

Soil Freezing Study

The soil freezing study described briefly in the last Bi-Monthly report is yielding some very interesting data. Although the data will not be analyzed until the coming summer, an examination of the observations indicates certain relationships.

In general, plots in open-land conditions started having concrete frost sooner than forest-land plots and have frozen concretely to greater depths. Within the forest-land plots, more concrete frost and deeper freezing has occurred in coniferous stands than in comparable hardwood stands. Plots in the younger-age-class stands have more concrete frost than the older stands; thus, seedling-sapling stands have more concrete frost than pole stands, which in turn have more than saw-timber stands. Disturbance or

destruction of the forest floor may have a considerable effect upon the occurrence of concrete frost. A light cutting operation with a minimum of disturbance to the forest floor appears to have little effect upon the incidence of concrete frost; areas that have been grazed tend to have more concrete frost than undisturbed areas of the same type and stand size class, the degree of difference depending upon the intensity of grazing. Destruction of the forest floor by fire results in a great increase in the incidence of concrete frost.

DELAWARE BASIN RESEARCH CENTER

by Irvin C. Reigner and Nedavia Bethlahmy

Weather

Precipitation for the present hydrologic year has been abnormally high so far. The 5-month total from October 1, 1950, through February 28, 1951, amounts to 28.34 inches as compared with 20.68 and 17.93 inches as recorded during the same months in water-years 1949 and 1950. Generally, rainfall in this locality is well distributed throughout the year; however, this 5-month total is more than 60 percent of the expected 45 inches of annual precipitation. Rainfall in November set a high monthly record with 8.46 inches, being 1.24 inches greater than the previous monthly high recorded in May 1949.

Ground Water

As a direct result of the record rainfall in November, ground-water storage reached record highs. One of the two indicator wells peaked immediately following the Thanksgiving Day storm, while the other well reached its peak on December 9. Water in the latter well rose to within 1 foot of the ground surface, nearly 3 feet higher than the previous high.

A recent news item commented on the effect of last year's earthquake in Assam, India, on the level of water in a well in Texas. Investigation revealed that large distant earthquakes (India, British Colombia, Italy) affected the ground-water level at wells in our own experimental forest. The effects were in some cases permanent, i.e., either a permanent rise or fall in the level of the ground water. The U.S.G.S. was notified of these facts. They are apparently making a continuing study of this phenomenon. The U. S. Coast and Geodetic Survey now informs us regularly concerning the occurrence of earthquakes, and in turn, we inform the U.S.G.S. of any changes that occur in our well hydrographs.

Soils

Soil-moisture tabulations were completed for all the soil moisture sites at Dilldown. These tabulations list the inches of water contained in a given soil horizon when a given resistance is encountered on the Colman meter. These tables are now being used to analyze the soil-moisture resistance data that have been taken at Dilldown.

A soil map of Dilldown was completed. We are now able to assign weights to the soil-moisture data on the several sites in order to determine the average soil moisture stored in the watershed.

The soils map shows the following distribution of soils, water surfaces, and road area within the Dilldown watershed.

		Percent of area
Dekalb stony sandy loam	-	69
Dekalb sandy loam	-	12
Upshur loam	-	6
Swamps (clay loam)	-	8
Boulder fields and streams	-	4
Roads	-	1

Soil-Moisture Losses

The computation of soil-moisture losses and an attempt to correlate these losses with climatic data has been a major project during the quarter.

It is now possible to compute losses in soil moisture at Dilldown watershed following the complete calibration of the Colman soil-moisture units. Changes in soil-moisture storage reflect additions of moisture by precipitation and losses due to gravitational drainage, transpiration, and evaporation.

During those periods between storms when soil moisture has dropped to field capacity or below, further losses are due to evaporation and transpiration and can be directly measured in inches of water.

If soil-moisture measurements were made daily, the loss in soil moisture from one day to the next is obtained. In certain cases, resistance readings were taken at longer intervals, in which case a periodic loss is obtained. These periods ranged from 2 to 4 days.

In order to determine daily soil-moisture losses, an attempt was made to correlate known soil-moisture losses with several climatic factors. The factors studied were: temperature and humidity (expressed as saturation deficit), wind velocity, moisture content of the soil, and a time-precipitation ratio which takes into account the time interval between the last storm

of more than 0.02" and the day in question, and the size of the last storm. Statistical analysis for losses during the summer months showed that only two factors were significant: the time-precipitation ratio and the saturation deficit. The regression equation is:

$$L = 0.041 + 0.087T_p + 0.391Sd$$

in which L = Loss in soil moisture in inches per day; T_p = number of hours since the last storm greater than 0.02" divided by 1000 times the amount of precipitation for the storm in inches; Sd = saturation deficit (calculated by averaging the Sd every two hours). Further work may change somewhat the value of the regression coefficients.

This equation will be used to compute evapo-transpiration losses during periods when soils are above field capacity and changes in soil moisture include drainage as well as evapo-transpiration losses. When the vegetation has been converted to a timber stand, the equation will be used, by comparison with measured losses, to evaluate the change in evapo-transpiration losses due to the vegetation change.

Interception and Stemflow

Data on interception and stemflow in scrub oak cover, obtained from measurements taken last summer, have been analyzed. Net interception was found to have a close relationship to size of storm, allowing the computation of the following equation:

$$I = 0.025 + 0.032\ P$$

in which I = net interception per storm in inches; P = total precipitation per storm, also in inches.

The above relationship closely follows relationships determined previously in chaparral brush types in California.

Vegetation Survey

An intensive survey of the vegetation on the watershed is planned for the forthcoming field season. An attempt will be made to delineate each feature of the vegetative cover which may have a differing effect on the water relations of the watershed. For example, the transpiration rate of the scrub oak may differ from that of other species; a dense cover will intercept more precipitation than a sparse cover. Thus, the position and areal extent of each distinct category must be known. A work plan for the survey has been prepared in rough draft.

Scrub Oak Conversion

As part of the continuing search for improved methods of site prep-

aration preceding planting in scrub oak lands, a demonstration of the Seaman Tiller was held at Dilldown last October. The demonstration was reported in the recent Winter issue of Pennsylvania Forests.

Results were so promising that the Pennsylvania Department of Forests and Waters has planned an experiment using the Seaman Tiller. Approximately eight acres of scrub oak land adjoining the watershed area have been laid out for treatment and subsequent planting. To date, weather conditions have not allowed operation of the Tiller but the site treatment will proceed as soon as the frost has gone.

Manuscripts

Reigner revised the report on Sedimentation in the Schoharie Reservoir, and sent in his comments on a similar report submitted by the S.C.S.

Bethlahmy submitted the following manuscripts for possible publication:

How Deep is a Deep Soil--an article proposing that the depth of soils be classified in accordance with the relation of the soil's reservoir capacity to the monthly rainfall during the warm season.

A method to Determine the Water Content of Soils--an article giving in detail the methods which were used at Dilldown in completely calibrating the Colman units.

Why Do Plants Wilt in Cold Weather--an article pointing out that one of the main reasons for the wilting of plants during freezing weather may be the unavailability of soil moisture.

The manuscript "Forest and Water Research at the Delaware-Lehigh Experimental Forest" prepared by Storey, has been forwarded to the Pennsylvania Department of Forests and Waters for publication.

Miscellaneous

Storey and Bethlahmy attended the Golden Anniversary Meeting of the Society of American Foresters held at Washington, D. C., December 14-16.

Eugene McNamara, recent Penn State graduate, has been hired as research forester by the Pennsylvania Department of Forests and Waters. One of Mac's main duties is to work closely with us on the Dilldown project.

John J. Coughlin, former student summer assistant, has been rehired following his graduation in Conservation at Lehigh University.

MOUNTAIN STATE RESEARCH CENTER

by George R. Trimble, Jr.

Fernow Experimental Forest

Watersheds.--Precipitation measurements were begun in February. Fifteen standard rain gages and three recording gages were installed over the five gaged watersheds. It is expected that eventually the number of gages in this network can be reduced without loss of accuracy because: (1) the total area of the five watersheds is only about 360 acres; (2) the watersheds are contiguous; (3) the topography is similar; i.e., steep mountainous country with elevations running from 2,200 to slightly over 2,800 feet. Observations to date show relative insignificant differences in precipitation catch, but of course no observations have been made on summer storms where greater differences would be expected.

Reduction in the number of gages will effect a big savings in time, especially in the field. At present it requires 6 hours to service these gages for every storm since the watersheds are relatively inaccessible and a large part of the road system is not passable in bad weather.

Water-level recorders and reference bars have been installed at four of the five stilling basins. Recording of stream-flow data will start on April 1 for these areas--a month before the beginning of the growing season. Some work still remains to be done on the fifth stilling basin but it will be in operation by April 15.

Skid-road erosion study.--An informal study to determine trends in skid-road erosion was started 2 years ago following logging of four .5-acre plots. Each plot was logged under a different cutting-practice level with different intensities of cutting and different road location and drainage standards. A comparison of changes in road cross sections for several years following logging will provide an estimate of the effects of these different cutting-practice levels on soil movement in skid roads.

The annual remeasurement of these cross sections has been completed and the data are being computed. In addition to remeasurement of the cross sections, the percent slope and the distance from each cross section to the nearest water bar above was measured. These measurements may give an indication of the effect of slope and of distance on the amount of soil moved in skid roads.

Trips

Trimble spent a 2-week in-service training period at Coweeta.

Visitors

Bernard Frank spent several days "on vacation" here. With Mrs. Frank, he hiked over a good part of the Fernow. He saw our watershed installations and watched the logging operations. We enjoyed and profited from our discussions with Bernie.

FLOOD CONTROL SURVEYS

by Arthur Bevan

GENERAL

Precipitation during the period averaged about 30 percent above normal for the Northeastern region. However, snow cover has been light and considerably below normal except in the Adirondacks where it was about normal during the earlier part of the winter.

Runoff, on the other hand, has been about normal except in New York, Pennsylvania, and West Virginia where stream flow has been well above normal.

Flood stages occurred in many streams during February in these states due to rainfall and melting snow. Flood damage, however, was light. At the end of March a tropical storm with heavy precipitation caused severe and extensive floods in New York, New Jersey, New England, and Pennsylvania. Northern New Jersey in the Passaic and Raritan watersheds was the most seriously affected and suffered heavy damage and some loss of life.

An ice jam on the Susquehanna River near Columbia, Pa., in February caused evacuation of many families, flooded the local water plant, and closed all factories for a period of 10 days.

The soil freezing studies being carried out in the New England-New York area are producing some very interesting results. The winter started out with very cold weather and little snow cover so that soil freezing was extensive. This condition has continued throughout most of the winter. In general, soil freezing started from the 1st to the 15th of December. Formation of concrete frost started first in all types of open land followed by clear cut forest areas and abandoned farm land reverting to forest. About January 1, concrete frost was found in most coniferous stands but depths were generally less than found on any type of open land. By the end of January concrete frost was found in hardwood stands, depths reached 1 or 2 inches but was patchy with a minimum of the concrete type. Concrete frost during February reached the maximum development. All open land contained concrete frost exceeding 10 inches depth. Concrete frost was found quite generally in all forest stands but averaged considerably less than on open lands.

Depending on the study location, considerable differences in thawing of concrete frost occurred. In some all frost disappeared from forest areas during March and was only observed in open lands. In central New York concrete frost started to thaw in open lands and by the end of March a large part of the frost had gone, whereas concrete frost still existed in the forest, particularly coniferous stands.

SURVEY ACTIVITIES

The tentative draft of the Merrimack Report is about completed. Work has been started on a draft of the Salt River (Ky.) report. Hydrologic analysis, development of the recommended program, and costs are about finished.

A work outline of the flood control surveys to be conducted in the New England-New York area is under way. A start has been made on work plans to guide the surveys in the selected watersheds. The collection and tabulation of existing data for land use inventories is proceeding and has been largely completed on the New York and Maine Rivers areas.

STATUS OF FLOOD CONTROL SURVEYS

Connecticut River.--Still in the Washington Office.

Merrimack River.--Tentative draft nearing completion.

Allegheny River.--No further progress.

Salt River.--Analysis and development of recommended program and costs nearing completion. Start made on rough draft report.

COOPERATION WITH SOIL CONSERVATION SERVICE

Delaware River report concurred in by Station. Submitted to Washington.

Youghiogheny River report reviewed and concurred in by Station. Being mimeographed for submission to Washington.

Lower Susquehanna River. All forestry phases of report completed and submitted to S.C.S.

Roanoke River report. Review by Forest Service completed and comments submitted to S.C.S.

A preliminary examination report and work outline for Cattaragus and Smoke Creeks (Pa.-N.Y.) has been reviewed and concurred in by the Station.

PERSONNEL

Tom Clark has transferred from Flood Control, Northeastern Station to the Green Mountain National Forest in charge of S.A.B. work.

Bert Husch has joined the Flood Control staff reporting March 12.

MEETINGS

Meetings of the New England-New York Inter-Agency Committee at Boston and Hartford were attended by several members of the Station staff. J. C. Rettie has been appointed Departmental representative on the Flood Control Working Group. Norman Tripp is his alternate.

Don Whelan has been appointed Departmental representative on the Hydrology Subcommittee of NENYIAC. He attended the first meeting held in Boston.

R-NRM
REPORTS
Quarterly
(Flood Control Surveys)

April 2, 1951

NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

Quarterly Report, Division of Flood Control Surveys

December - March, 1951

For this period, emphasis of the Flood Control Division of the Northern Rocky Mountain Station was directed toward the assembling of basic information necessary for the first phase of the flood control and Columbia Comprehensive report. A few meetings and conferences were necessary to clarify topic assignments and to resolve heretofore unforeseen obstacles. With due dates rapidly approaching, continued emphasis in this direction must be made.

P.W.I.

The listing of P.W.I. items for all national forests in the Upper Columbia Basin have been completed. P.W.I. items have been summarized by forests and are now being coordinated regionally. All forests are now typing the final forms and will soon release the rough forms to the Division of Flood Control Surveys for use in some of the special flood control analyses.

Hydrology

Ten special snow courses were installed in northern Idaho early this winter. All are located in low density timber stands or brush fields. These 10 courses together with the 8 courses previously established at the headwaters of the Clark Fork and Blackfoot Rivers are measured cooperatively by NFI and Flood Control personnel. Readings from these courses will fill one of the gaps in our ground cover-snow relationships.

Compilation of streamflow data from the Benton Creek weir is under way. Summaries through 1950 will soon be completed.

Analysis of snow accumulation and melt is being made currently. Final analysis will not be made until this winter's measurements are complete.

A report on "Operation Snow Pack," last described in the October-November bi-monthly report, is nearing completion. These single season's observations verify conclusions of other studies and reveal some additional information. One of the more important conclusions is that brush cover has negligible effect on snow accumulation and on snow melt rate; in fact, snow melt rate on some brush sites actually exceeded that in adjacent grass and open areas. As expected, it was found that heavily forested areas accumulate less snow than open areas; that melt rates under timber were lower than on grassland or cut-over sites; that courses in patchy clumps of timber tended to accumulate more snow than those in open areas.

Land Use

Compilation of first level land classifications by ownerships for the Upper Columbia area are about complete. Second level breakdowns will be started as soon as standard breakdown procedures have been crystallized.

A generalized type map of the Upper Columbia has been compiled in accordance with the 8 standard forest and 5 range types suggested by the land use committee and proposed to the C.A.P. field committee.

McBee sorting cards have been prepared for the plot data taken on the four study watersheds. These cards are now ready for analysis. It is planned to collect similar data on the three remaining watersheds this summer.

Damage Appraisals

Damage appraisal data collected on national forests are being assembled and evaluated. Collection of damage data on areas outside the national forests is going forward. Division of responsibility for damage collection between the Forest Service and Soil Conservation Service in the northeast part of the basin has been agreed to by a meeting with members from this office and the S.C.S. officials in Spokane.

Priest River Experiment Station

Compilation of field data taken since snow studies were started in 1948-49 is nearing completion and analysis of the observations will be started in the near future with some preliminary work now underway.

Accumulated precipitation measured at Priest River Experiment Station for the period September 1 through February exceeded that measured during any like period for the past 30 years. This winter's accumulation was greater than 1947-48 - the preceding wettest period - by approximately three inches.

In early March, an 8-inch core taken in newly fallen snow contained 0.25 inch of water. This snow density of only 3-1/8 percent is the lowest ever measured on any of our courses. We wonder if it constitutes a record.

Meetings and Miscellaneous

Director Jemison, Dickerman, and Friedrich attended the Montana Conservation Council meeting at Bozeman January 10-12. The group discussed proposed conservation education bills. The council sponsors the Montana Conservation Caravan.

Baudendistel spoke at the Advanced Management Training Encampment conducted by NFA at the Remount Station on January 24 and 25. His topic was "Watershed Management Philosophies." At the same school, B. A. Anderson of the Secretary's office spoke on "Basin Land and Water Resources Development."

Jemison read a paper before the Missoula Rotary on January 10 entitled "Water." He illustrated his topic with Flood Control slides.

The Montana Natural Resource Council of State and Federal Agencies meetings at Billings were attended by Friedrich in December and Baudendistel in February. The main topic for discussion was the Water Resource Policy Commission Report.

Baudendistel gave a talk before the Inland Empire Section of the Society of American Foresters at Spokane on February 24. His topic was "Importance of Watershed Management." At the same meeting, Dean D. S. Jeffers of the University of Idaho spoke on the "Importance of Watershed Management in Land Use."

Friedrich gave a lecture during the NFA Range Management Encampment March 14 at the Remount on "Watershed Problems in Relation to Range Management."

Helmers read a paper before the Northwest Scientific Association at Spokane in December. His topic was "Measuring Rainfall on Windswept Slopes."

Members of the CBFSCC and Board of Survey met in Missoula March 14 and 15. Here it was decided to add one flood control member from each station to the CBFSCC and to the Liaison Committee. Baudendistel was selected to fill the positions for the NRM Station. Assignment of topics as listed in the Tentative Working Plan was clarified.

Director Jemison, and Baudendistel made a functional inspection of work at the Priest River Experiment Station on February 26 and 27.

Baudendistel, Friedrich and Weyermann contacted SCS officials in Spokane on March 5. Delineation of areas of responsibility and survey methods were discussed. On March 6, the same party contacted B.L.M. officials to acquaint them with the Flood Control program and to obtain basic area figures.

Baudendistel and Weyermann contacted B.L.M. officials at Billings on March 20. On the same day, they contacted officials of the Indian Agency at Billings. The Flood Control program was explained. Basic area figures were obtained.

On March 27, Friedrich contacted the Superintendent of the Blackfoot Indian Reservation and obtained basic area and land classification figures. He also contacted the Superintendent of Glacier Park for the same information.

On March 27, Weyermann contacted the Superintendent of the Flathead Indian Reservation for basic area and land classification figures on that reservation.

Personnel

Norman Tripp accepted a transfer to the Division of Flood Control Surveys, Northeastern Forest Experiment Station, effective January 13. He has been replaced by George F. Weyermann from Region One NFA.

Richard Alvis, who works on soils in this office, was detailed to the Priest River Experiment Station to assist Helmers in snow course measurements, etc., for a temporary period.

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION

Quarterly Progress Report, Division of Flood Control Surveys
January 1 - March 31, 1951

Direct Survey Work

Most of the effort of flood-control survey technicians has been spent on hydrologic analyses of flood relationships for 15 selected sample watersheds in western Washington and Oregon. Up to now we have not had a great deal of success in establishing a significant relationship of flood peak discharge to variables expressing the effect of cover. This is probably due to the fact that most flood-producing storms in this general area occur in the form of winter rain, of relatively low intensity but quite protracted in nature, during that part of the year when the consumption of water by evaporation and transpiration is naturally at a minimum. Up to now, the size of flood peaks has been found to be best related to the area of each watershed occupied by forest cover less than 20 years old.

Work is also in progress on watersheds east of the Cascade Mountains, where we are collecting, tabulating, and mapping data on precipitation, temperature, and stream flow and cover types. Hobbs and Iwerdal have been working on this job full-time; Barton and Hale part-time.

A report by this Station on "Floods of October 1950 in Southern Oregon" was put in final form in January and distributed in February.

In March, H. J. Fittinger was transferred to this Station from the California Station to work on flood damage surveys and engineering plans.

Sediment sampling was continued on all streams previously sampled, and two more streams in southwest Washington were added to the list. High water in late January and early February brought sediment loads up to 11,000 ppm in a couple of streams; but most of the winter the observations have run between 40 and 100 ppm. Barton has worked on this study about half time.

The frost study was continued on the eastern Oregon range areas under Hale's guidance, but there is little to report. We have had a mild open winter, with very little soil freezing.

Comprehensive Program Activities

Nelson met with the Forest Service Columbia Basin Coordinating Committee January 22 - February 2 in Portland to correlate unit costs on Project

Work Inventory measures and to lay plans for future activities of the Committee in collecting and correlating program data for the comprehensive program. Action was initiated to clarify the Committee's relationship with respect to the Forest Service representative on the Field Committee and to the Region on the various aspects of program formulation.

A training session was held early in January for administration and flood-control members of the PWI data collection teams.

The Project Work Inventory for all forests and ranger districts of Region 6 was carried out from mid-January to mid-March. Bullard and Sartz were assigned from the Flood Control Survey to help in the Inventory. Of interest and concern to Flood Control were the program recommendations involving tree planting, grass seeding, shrub revegetation, rodent control, weed eradication, erosion control, stream channel improvement, range water developments, dam construction, and land rehabilitation; the apportionment of these programs by area according to forest and range cover types; and the collection of data on the area of National Forest land in the slight, moderate, and severe sheet erosion classes, the extent of gully erosion, and the prevalence of landslides. On the side, considerable information was picked up from the rangers on storm and flood occurrences and on flood damages.

Nelson continued his work with FSCBCC and with the Field Committee. The team approach to the collection of PWI data has given Flood Control representatives a good understanding of field problems and an opportunity to discuss flood-control objectives and interests with every ranger in the Region.

Collection of data on land areas in various forest, range, and crop land cover types continues, and will soon be completed. Hale has worked with the Bureau of Land Management and with the Division of State and Private Forestry in the Regional Office on this project.

At Mr. Peet's suggestion, Wilm and Hatt of the Soil Conservation Service made official contacts with the Portland agency heads of the Department of Interior, so as to clear the channels for Department of Agriculture personnel to obtain data for the comprehensive program. As a result of these contacts, the Department of Interior agencies are now preparing data on basic land area characteristics, which are to be turned over to us by April 1.

Late in March, men from the three Forest Service regions and stations directly interested in the Columbia Basin program met at Missoula to consider mutual problems and to somewhat reorganize interregional relationships in carrying through the program work. As a result of these discussions, the Forest Service Columbia Basin Coordinating Committee has expanded so as to include representatives from the Intermountain

and Northern Rocky Mountain Stations as well as the Pacific Northwest Station. By this means there are now one Station and one Regional man officially responsible for spearheading technical activities on the comprehensive program in each Forest Service region.

R - RM
REPORTS
Quarterly - FI

April 1, 1951

QUARTERLY REPORT
January 1 to March 31, 1951

Forest Influences Division
Rocky Mountain Forest and Range Experiment Station
Fort Collins, Colorado

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Forest Influences Division - Fort Collins

Several memorandum reports were prepared for the field committee of the Arkansas-White-Red river basin. These reports dealt with the conditions of vegetation and soils of the upper Arkansas basin. A general research program is now under consideration which will include a revision of Project Work Inventories for that part of the basin.

The Soil Conservation Service Flood Control Surveys Office at Albuquerque, New Mexico, completed a summary of the stream-flow and precipitation records at both the Manitou and Fraser Experimental Forests. The effort is to assess the effects of present vegetative cover on stream flow as well as the characteristics of various storms. It is part of an over-all study which the Soil Conservation Service is making in the states of Arizona, New Mexico, Utah, and Colorado. All records were made available to the Soil Conservation Service and the actual summary was accomplished by their own personnel.

The 1950 Annual Report for the Rocky Mountain Station was organized and edited by E. G. Dunford of the Division. The report summarized the work done by the Station during the past year according to the three disciplines of watershed, range, and timber-management research. An important note was the recognition of the need to adjust the station's present research toward the Nation's defense effort.

A special study was completed in the laboratory to determine whether both the Bouyoucos blocks and the Colman meters could be used to measure the path of soil moisture in the gravelly mountain soils which occur on the Fraser Experimental Forest. Both were effective; however, the Bouyoucos blocks measured only the period of time in which soils were above field capacity while the Colman meters not only recorded the duration of saturation but also the amount of moisture present. To further explore the use of the blocks and meters, it is planned to install them in four pits to a depth of 5 feet in the soils found on the Fool Creek watershed. The installation will be made early in April in order to obtain some relation of soil moisture to the 1951 snow-melt runoff. Periodic soil-moisture samples will be taken to check the readings of the instruments.

Manitou Experimental Forest - Front Range

Through the use of the Rocky Mountain infiltrometer (Type FA), a study of the infiltration and erosion rates was made on three vegetation types occurring on the Missouri Gulch watershed. The types examined were aspen, ponderosa pine with an understory of grass, and the mountain-brush type consisting mostly of mountain mahogany. Aspen was found on the north and east exposures while the other two types occurred on the south and west exposures.

Results of this study show that the aspen type, by virtue of its high infiltration rate and low erosion rate, provides superior watershed protection. The ponderosa pine type, although having a moderately high infiltration rate, has also an accelerated erosion rate amounting to 7 cubic feet of soil per acre per inch of surface runoff.[1/] This rate is not as serious as that found on the mountain-brush type where the erosion rate amounted to 30 cubic feet of soil per acre per inch of surface runoff. Infiltration rates of the mountain-brush type are moderately high, but the runoff which does occur moves large quantities of soil. Unlike the other two types, the ground surface is not well protected by plants or litter, often consisting only of a bare gravel pavement from 1 to 2 inches thick. It is capable of absorbing water rapidly due to its gravelly nature, but is highly erodible even when small surface flows of water occur. Our tests show that among the cover types we studied, mountain-brush type provides the poorest watershed protection, ponderosa pine-grass type is intermediate, and aspen is the best.

These results are summarized in table 1 which gives average infiltration and erosion rates for the three vegetative types:

Table 1.--Infiltration and erosion rates for three cover types in Missouri Gulch watershed. Manitou Experimental Forest

Vegetation type	No. of plots	Range in slope (percent)	Infiltration rate (f_c) (in./hr.)	Erosion rate[1/]
Aspen	12	9 - 41	4.30	[2/] 16
Ponderosa pine	10	9 - 39	3.14	557
Mountain brush	10	24 - 56	3.22	2,356

1/ Pounds per acre per inch of surface runoff
2/ Only 2 of 12 plots yielded erosion

When the soil surface of granitic-derived soils is devoid of live vegetation or litter it is susceptible to water erosion. More particularly is this true on slopes where a sparse vegetative cover occurs and where the force of rain is broken only by a gravel pavement. A significant correlation was obtained between the percent of bare area and the erosion rate measured by infiltrometer plots randomly located in the three vegetation types. This comparison provides an erosion-rate index for granitic-derived soils regardless of vegetation types. Expected relation between erosion rate and percent of bare area, calculated from data in this study is:

Bare area (percent)	Erosion rate (Lbs./A./In. surface runoff)
0	236
10	490
20	744
30	998
40	1,252
50	1,505
60	1,759
70	2,013
80	2,267
90	2,521
100	2,774

1/From limited volume-weight studies, a cu.ft. of soil in Mo. Gulch drainage weighs about 78 pounds.

Instability of the granitic-derived soils is illustrated by the expected rate of erosion (236 pounds per acre per inch of surface runoff) when the soil surface is completely covered by live vegetation or litter. It amounts to some 3 cubic feet of soil moved per acre. Even with half of the soil surface covered, the erosion rate is high--over six times that of complete cover. On the granitic-derived soils, particularly the steep slopes, it is important to maintain as much live vegetation or litter on the soil surface as possible in order to reduce surface soil movement to a minimum.

Commonly, the soil surface of the granitic-derived soils is covered with a gravel or erosion pavement. This pavement is composed of the coarse gravels remaining after the fine particles have been washed down through them or carried away completely. These gravels vary from the size of a small pea to egg-sized stones. On steep slopes the beating of raindrops, together with the movement of surface water, causes the gravels to creep downslope, particularly where the soil surface is bare. Soil moved on all of the infiltrometer plots was analyzed as to particle size and summarized as follows:

Soil particles	Average proportion by weight (percent)
Coarse and fine gravel (1 mm. or more)	55
Coarse sand (0.5 to 1 mm.)	17
Medium sand (0.2 to 0.5 mm.)	19
Fine sand, silt, clay (0.2 mm. or less)	9
	100

The "fines" (fine sand, silt, and clay) are located underneath the gravel pavement and are thereby protected from the beating action of the infiltrometer raindrops. Once the gravels are moved by the rain or the surface movement of the water, the fines are washed out. It would appear that, although a gravel pavement does protect the soil surface to some extent, it is not as effective as live vegetation or litter. Gravel can be moved by water subjecting the soil underneath to washing. On the contrary, plants are less subject to movement and tend to hold soil particles in place.

An intensive study of three 1-acre experimental watersheds showed the trend of soil moisture under a variety of conditions. The watersheds are a part of a series on which we are investigating the relation of vegetative changes to runoff and erosion. Two of the three watersheds used in this study have had all the ponderosa pine removed and the third remains in its original condition.

Samples were taken with a soil tube for a period of 9 weeks during July, August, and early September. Ten randomly chosen sample points were selected within each watershed every week. Each succeeeding week new locations were randomly selected. Depth of measurement was 18 inches from which two subsamples of 0-6 inches and 6-18 inches were obtained.

The results showed a significant difference in moisture content between watersheds for the entire 9-week period. In addition, they pointed to a very strong correlation between soil moisture and two factors: direction of exposure and litter density on the ground surface. The relationship with exposure held true for both the 0-6-inch and 6-18-inch zones, but litter density showed a weakened relation to soil moisture in the 6-18-inch zone. The number of live plants per square foot was weakly correlated with soil moisture in the upper zone, and showed no influence at all on moisture in the lower zones. Litter density had a positive relationship with soil moisture, indicating that it protects soil from drying. Live plants had

the opposite effect or a negative correlation. In other words, the transpiration draft of live plants tends to dry the soil, more than offsetting whatever effect their shade may have in reducing evaporation.

A preliminary study was made at the experimental forest during July and August to obtain knowledge of the effect of summer storms on soil moisture. Soil moisture was sampled at depths of 3, 6, and 9 inches below the ground surface in an open park covered with crested wheatgrass. Measurements were made at frequent intervals by means of Colman meters. During a 20-day period in mid-July, 14 storms occurred, 4 of which equalled or exceeded 0.4 inch of rainfall. At this time soil moisture at all three levels was about equal. A subsequent dry period caused the moisture content of the entire profile to drop sharply. During the last week in August, five storms occurred, each bringing less than 0.2 inch of rainfall. Soil-moisture content of the soil was very low with the result that the surface measurements in the upper 3 inches were the only ones reflecting any substantial increase in moisture content. No general conclusions are possible because of the limited nature of the study.

Western Slope Research Center - Delta, Colorado

Infiltration and erosion tests were made on nine sites representing distinctive characteristics of range in both good and poor condition. The sites were in open parks and aspen woodland on the Black Mesa of the Gunnison National Forest. Summaries of these studies are found in tables 2 and 3.

Table 2.--Infiltration and runoff for selected range-watershed subtypes and conditions on Black Mesa

Subtype	Soil texture	Average slope	Average infiltration rate	Surface runoff from applied rainfall
		percent	in./hr.	percent
Open parks				
Good bunchgrass	Sandy loam	15	4.8	3
Lush weed	Loam	13	4.5	8
Poor bunchgrass	Loam	18	4.2	9
Bromegrass-weed	Loam	12	4.2	13
Needlegrass	Gravelly loam	16	3.6	24
Poor weed	Clay loam	15	2.5	42
Bluegrass	Heavy loam	10	2.3	48
Aspen woodland				
Poor aspen	Gravelly loam	22	4.8	2
Depleted aspen	Loam	27	3.9	25

Good bunchgrass and poor aspen proved to be good watershed cover. Both had average infiltration rates of at least 4.8 inches per hour. Aspen stands on Black Mesa present watershed problems only when seriously depleted. Even under these conditions infiltration approached the rate of 4 inches per hour.

Three other subtypes on Black Mesa were almost as good. Lush weed, bromegrass-weed, and poor bunchgrass showed somewhat less capacity to absorb water, but the difference could have been chance occurrence. On Black Mesa, all sites with infiltration rates in excess of 4 inches per hour may be considered to have adequate protection. Less than 15-percent runoff can be expected to occur from high-intensity storms. Needlegrass subtype is intermediate in capacity to absorb water; poor weed and bluegrass, the lowest. These last two absorbed only slightly more than half the total rain applied and apparently are sources of concentrated runoff during severe storms.

Poor weed subtype appears to offer the most serious erosion problem on Black Mesa. Soil movement at the rate of nearly 2 tons per acre for each inch of surface runoff means critical watershed conditions prevail. If 200 pounds of eroded material per acre per inch of surface runoff is an allowable maximum for adequate watershed management, good bunchgrass, bluegrass, and poor aspen subtypes on Black Mesa provide acceptable cover. More complete sampling may prove that lush weed and depleted aspen also provide average conditions which approach acceptable standards for erosion control.

Table 3.--Relation of litter and bare area to soil movement on Black Mesa. 1950.

Subtype	Litter cover 1/	Bare area 1/	Erosion rate 2/	Total soil loss from applied rain 3/
	Percent	Percent		Lbs./A.
Open parks				
Good bunchgrass	56	12	57	10
Bluegrass	47	21	181	251
Lush weed	28	31	304	102
Bromegrass-weed	48	21	723	156
Needlegrass	34	37	764	552
Poor bunchgrass	47	21	1,006	479
Poor weed	12	62	3,372	5,737
Aspen woodland				
Poor aspen	61	13	0	0
Depleted aspen	88	4	219	171

1/ Estimates obtained by sampling each site with 25 plots
2/ Pounds per acre per inch of surface runoff
3/ Rainfall was applied at the average rate of 5 inches per hour for 50 minutes

Bluegrass is an enigma in range and watershed management. Many observers have doubted its value in watershed protection in spite of an appearance of a good cover. Data from Black Mesa are by no means conclusive, but they do show that bluegrass has both good and bad features. Surface runoff from bluegrass sites was the highest of all subtypes and conditions tested, but rates of erosion in pounds per acre per inch of surface runoff were third lowest. However, since relatively large amounts of water flow over the surface during a given storm, the total quantity of soil transported is intermediate in amount. High surface runoff appears to be the worst feature of bluegrass. While it offers moderate protection to its own site, it tends to shed destructive flows of water to downstream sites with poorer protection.

It is further evidence that erosion is strongly related to bare area. Bluegrass forms a rather dense mat over the soil surface and while it has poor absorptive capacities, it provides relatively good protection against soil movement. If the same low infiltration rates prevailed on poorly covered sites, erosion would increase manyfold.

Fraser Experimental Forest - Continental Divide

Almost all the water in high mountain streams is delivered through the soil. Moisture used by lodgepole pine and Engelmann spruce during the summer must be replaced before the soil reservoir will again feed water to the streams. Amounts of water these trees take from the soil reservoir and the depth of their moisture-feeding zone have never been precisely measured.

Table 1.—Relation of litter and bare area to soil movement on Shedd Farm, 1950.

The logging road under construction in the Fool Creek watershed exposed many deep cuts where the soils could be studied to considerable depths. The summer had been very dry, and the trees had probably extracted all possible moisture from the soil. Using due sampling precautions, soil samples were taken from five deep profiles at intervals from the surface down to depths of 4 to 9 feet. The samples were taken on September 21 and 22. In the previous 10 days, the summer drought had been broken by 1.4 inches of rain, 0.48 inch of which fell in the 2 days preceding sampling. This moisture brought the surface soil to field capacity but left the deeper layers very dry. Moisture percentages obtained were based on oven-dry weight of the whole soil sample which included gravel.

In all profiles, the tree roots extracted the moisture nearly uniformly to a depth of 36 inches. Soil moisture showed a gradual increase between 36 and 60 inches, and the data indicated that extraction of moisture by roots had nearly ceased or was unimportant below a 60-inch depth.

The average moisture percents for the newly wetted surface, the dry subsoil, and the moist deeper soil layers are shown below.

	Average moisture (percent)	Range in moisture (percent)
Surface soil	10.2	6.6 to 16.8
Subsoil (to 36 inches)	7.3	4.4 to 13.0
Deep soil layers (below 36 inches)	11.7	5.8 to 20.5

Values are averages based on dry weight of all samples within the depths indicated. The range in moisture percent can be explained by the amount of gravel in each sample--the more gravel the less moisture the soil will hold. Average moisture percent for the subsoil was 7.3, but four of the five profiles had one or more points that fell between 4.4 and 6.9 percent in the subsoil, with an average value of 5.6 percent. It is believed that this 5.6 percent value gives a truer measure of subsoil moisture after trees have extracted all they can get.

Moisture-deficit at the time of sampling can be estimated with a fair degree of accuracy. If it can be assumed that surface and deep soil layers were at field capacity, the average moisture percent of the two, 10.9 percent, can be used as an estimate of the percent of water held by the soil in this condition. Also, since the trees had drawn upon the water in the subsoil all summer it is likely that a moisture content of 5.6 percent in this zone approaches the wilting point. The difference between this figure and the 10.9 percent of field capacity suggests that the soil had a moisture-deficit of 5.3 percent to a depth of 36 inches before fall rains moistened the surface again. In earlier studies we found that soils in the vicinity have an average density (volume weight) of 1.57. From this figure we can calculate the indicated deficit for the upper 36 inches of the soil mantle at about 3 acre-inches of water. In exceptionally dry seasons when trees have extracted all the moisture possible and fall rains do not relieve the dry condition, about 3 acre-inches of snow water are required from the spring melt to satisfy soil deficiency before streams can begin their seasonal rise.

There has been a long-standing need for methods to follow the progress of snow-melt over large watersheds with wide ranges of elevation, exposure, aspect, and cover condition. Methods involved the periodic mapping and photographing of snow cover on:

1. The entire experimental forest above main St. Louis Creek stream gage.
2. Adjacent north and south slopes in detail.

St. Louis Creek watershed.—Ocular estimates of the percent of the watershed area covered with snow were made weekly for each subdrainage from three observation points. The areas covered with snow were then drawn on maps, planimetered, weighted according to percent cover, and an average percent snow cover determined for that day. A detailed study of these maps will be made in order to correlate snow disappearance with climate and topography.

The snow-melt season in St. Louis Creek watershed lasts about 3½ months, from early April to late July.

1. The first snow disappeared about 15 days before any stream rise was noted.
2. The time of most rapid snow disappearance coincided with the time of peak stream flow (June 16).
3. The last snow disappeared about 30 days before stream flow dropped to the summer level.
4. The snow-melt curve (percent snow cover plotted against time) coincided almost exactly with a stream-flow curve (remaining percent of the total volume of stream flow for the period April 1 to July 12, plotted against time).

Percent of snow cover and stream flow in cubic feet per second for corresponding dates in the St. Louis Creek watershed are shown in table 4.

Table 4.--Relation of snow-cover disappearance to rate of stream flow in St. Louis Creek watershed, Fraser Experimental Forest. 1950.

Date	Snow cover	Stream flow
1950	Percent area	Cu.ft./sec.
April 1	97.7	9
4	100.0	9
14	94.9	12
27	93.5	12
May 9	91.7	20
12	89.2	23
19	90.0	42
June 6	70.1	135
13	49.2	212
20	36.3	200
27	18.7	145
July 3	7.2	113
12	2.1	74

North-south slopes.—Studies were made on adjacent north- and south-facing slopes of West St. Louis Creek to determine the relative rates of snow disappearance. Two snow courses and four precipitation gages were measured weekly on each slope. Relative rates of disappearance corrected for precipitation are shown in table 5. Snow courses on the south slope were bare of snow about a month ahead of those on the north slopes.

Table 5.--Relative rates of snow disappearance on north and south slopes. All data corrected for precipitation. Fraser Experimental Forest. 1950.

Date	Snow disappearance in inches of water equivalent	
	North slope	South slope
1950	inches	inches
April 5 - 12	0.86	2.78
12 - 19	1/ ----	2.15
19 - 26	1.51	4.39
26 - May 3	1.56	2.75
May 3 - 10	1.33	1.59
10 - 17	2.01	1.30
17 - 24	3.28	----
24 - 31	1.35	----
31 - June 7	5.56	----
June 7 - 14	2.30	----
14 - 22	0.88	----

1/ No measurable loss

The 1951 field season at the experimental forest began with the opening of the station on March 19 by Dunford and Love. With the exception of a few wind measurements, all instrumentation was installed by April 1. Preliminary indications point to a winter snow storage of some 2 inches more than occurred in 1950. Work for the most part will be confined to the Fool Creek watershed because of the limited personnel available. As many of the recommendations by the Fool Creek Jury will be carried out as possible during the course of the field season.

Personnel

Several personnel changes have affected the work of the Division. E. J. Dortignac has transferred to the Washington Office with a field station headquarters at New Orleans to head up a cooperative project with the Corps of Engineers. H. E. Brown has been called to military duty with the Marine Corps. J. L. Retzer is on a 4-month assignment to the California Station doing soil surveys on a flood control project. Release from the special Roosevelt Study has allowed Love to devote his time to the activities of the Division. We are now down to two men; will welcome any help anyone offers.

Publications

"A method of comparing two experimental watersheds" by B. C. Goodell has been submitted to the Transactions of the American Geophysical Union for publication.

"The effect of thinning young lodgepole pine on water available for stream flow" by B. C. Goodell has been submitted to the Journal of Forestry for publication.

"Design and operation of Rocky Mountain infiltrometer" by E. J. Dortignac is now being printed as Station Paper No. 5, and soon will be available for release.

"Water absorption as affected by vegetation and soil in Colorado pine-bunchgrass range" by E. J. Dortignac is in final manuscript form awaiting the selection of a board of review.

Visitors

Early in February, J. K. Brandeberry, Forest Service Representative on the Missouri Basin Field Committee, and Bill Blair of the New York Times, visited the Fraser Experimental Forest. (Temperatures dropped to 49° below zero.) As a result of the visit two articles describing the work at the experimental forest appeared in the New York Times during mid-February.

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QUARTERLY REPORT
Flood Control Surveys
and
Forest Influences Research
Southern Forest Experiment Station

December 1950 - March 1951

Flood Control Surveys

Activities during this period were many and varied, with numerous unscheduled jobs claiming attention from time to time. Report revision was a main order of business, particularly modification and reprocessing of the Upper White report to put it in shape for Department review. Also pushed to completion on a tight schedule were the Station's contributions to the SCS Upper Arkansas and Apalachicola surveys. Work on the Ouachita and Lower White surveys went forward concurrently as press of other work would permit and various jobs of a service nature for the Arkansas-White-Red Basin study were also completed.

General Activities

Meginnis spent several weeks in Washington in February on a special flood survey assignment.

Arrangements were made with Region 8 for a series of future conferences with the Regional Forester and staff to consider forestry recommendations when these have been formulated for current survey projects. Particular attention will be given to formulation and review of acquisition proposals. Similar discussions, involving Regions 8 and 9 and State Foresters in Arkansas and Missouri, are planned when a tentative forestry program has been developed for the Lower White watershed.

Meginnis conferred with Supervisor Gerrard in Little Rock, March 15, in regard to FS recommendations for future administration and management of unappropriated public domain lands in Arkansas. There are about 137,000 acres in this status, chiefly in the White River Basin. They are mainly low-grade forest lands of the type recommended for acquisition and watershed treatment and hence deserve special consideration in flood survey recommendations.

Stanley Ursic, GS-5, Research Forester, joined the flood survey staff, effective February 19.

Upper White Report

The Upper White report underwent major revision during this period to incorporate changes and suggestions from field reviews by Federal and State agencies. Stephenson spent January 31 through February 11 in Washington conferring with representatives of BAE, PMA, and the Secretary's office in regard to this report.

On his return to New Orleans, additional changes were made in accordance with the informal reviews by the consulting USDA agencies, and the revised report was then processed early in March for submittal to the Department. However, transmittal has been held up indefinitely on advice of the Washington office pending FS decision on certain policy matters affecting forestry recommendations in flood survey reports.

Ouachita Survey

Good progress was made on data computations and analysis during this period. Estimates of present runoff and flood damages were completed for the entire watershed and for future conditions with the recommended program in effect for portions of the area. During March, a method was developed for appraising effect of going forestry programs on hydrologic condition of forest lands in the future. This is a basic procedural step which will figure in allocation of future benefits between going and recommended programs.

With flood damage estimates available, work proceded on an analysis of engineering data from the detention reservoir study. Field work on this project was completed last November and was concentrated mostly in the watershed of the North Fork of the Saline River where field reconnaissance had indicated there was some prospect for developing a favorable case for these structures. Sites were surveyed for eleven reservoirs in this drainage. These impoundments were designed to temporarily store about 7-1/2 inches of runoff from drainages of 3 to 12 square miles. As was anticipated preliminary analysis indicates that there are insufficient damages, even in the Saline River area, to justify detention reservoirs. Total annual costs for the system of eleven reservoirs are estimated at $80,000, and total benefits (including a liberal allowance for enhanced land use) at about $12,000, or cost-benefit ratio of 1 to 0.18. Before final conclusions can be drawn, SCS technicians who participated in the study will be consulted to ascertain whether modifications in design or other appropriate adjustments are feasbile or would appreciably change the cost-benefit ratio.

Additional progress was made in formulating estimates of non-crop flood damage in the Ouachita watershed. Basic data of this type are very meager and additional field study to strengthen the estimates is desirable if time and resources permit.

Lower White Survey

Field work continued in the Lower White watershed about on schedule, despite unusually severe winter weather. Technicians detailed from the SCS Kansas City office completed soils and land use mapping on sample areas in the Missouri portion of the watershed. Surveys of valley cross sections on sample reaches and tributary areas were completed in February. Classification of floodplain use and damages is in progress and will be completed in early April. This will bring to completion most of the basic field surveys involved in land classification and damage appraisal.

Early in February, Foster visited the USGS and Corps of Engineers' offices in Arkansas and Missouri to obtain engineering and hydrologic data. Analysis of streamflow records and preparation of frequency curves is well under way.

Arrangements were made with the Fort Worth SCS office for detail of engineering personnel to make surveys of detention reservoir needs in the Lower White Basin. This work will be started in the spring. It will require a more thorough study of this phase than the Station has attempted heretofore, inasmuch as local interests, particularly in Missouri, have requested consideration of small headwater dams and channel protection works as an alternative to Corps of Engineers' projects downstream. Field surveys in the Lower White Basin are disclosing substantial flood damage on small tributaries with definite indications that the prospects for small detention reservoirs are more favorable than in the Ouachita and Upper White watersheds.

Davey--on continuing detail from SCS--was able to spend only part time on Lower White activities during the period, being on active duty with the Air Force Reserve for several weeks and also assigned to various SCS projects. In addition to supervising and coordinating field work, he made a thorough study of the available information from conservation surveys in Arkansas and has selected representative data for further analysis.

Cooperative Relations with SCS

Much work went into an unscheduled job--revision of the Savannah report--as a result of questions raised in FS staff review in Washington. The main questions were concerned with:(1) fire protection needs in the Georgia portion of the watershed, (2) the proposed cost sharing arrangement for tree planting on private lands, and (3) the omission of acquisition proposals. After conferences with the Spartanburg SCS office and Region 8, forestry recommendations were revised, woodland benefits re-evaluated, and a complete re-draft of material for the forestry sections of the report were supplied SCS. Some of the changes were made necessary by SCS decision to omit recommendations for the Coastal Plain inasmuch as no damages or benefits were claimed in that area.

Work on forestry phases of the Apalachicola survey was also a major activity of the survey staff. In January, Stephenson, Spector, and Langdon conferred with SCS people in Spartanburg and several days were spent subsequently in Atlanta in conference with Region 8 to obtain basic data. Langdon later conferred with State Foresters in Atlanta, Montgomery, and Tallahassee; and development and evaluation of a forestry program, together with preparation of descriptive material, required a major portion of his time during February and March. Others, particularly Spector, Stephenson, and Meginnis, also spent considerable time on this project. By late March draft material for the forestry sections of the report were submitted to Spartanburg completing the Forest Service contribution to this project.

In connection with the Apalachicola work, Langdon, in company with Stevens of the Regional office, spent several days in the watershed observing watershed conditions and sizing up need for acquisition and other measures. The field trip afforded opportunity to see the famous Stewart County gullies in Georgia. Some of these are still active and display erosion in its more spectacular forms. However, it is the consensus that these gullies are too scattered and few to require public acquisition or other special consideration in flood survey recommendations.

The Station's contribution to the Upper Arkansas report was completed on schedule and transmitted to the Fort Worth office in January. Forestry recommendations as developed in this survey apply to the Cross Timbers in Oklahoma and to the rather limited areas of the Ouachita Mountain forests which adjoin the Cross Timbers on the east. Recommendations provide for extensive fire protection, a limited tree planting and technical aid program, and acquisition of a nominal acreage of mountain lands immediately contiguous to those which will be recommended for purchase in the Lower Red watershed.

Although Forest Service participation has largely been waived in the Washita watershed, the Fort Worth SCS office recently prepared and sent to the Station for review drafts of material which are to be included in the report on the re-survey of this watershed. The proposed forestry program as developed by SCS was adapted largely from material the Station submitted for the adjacent Upper Arkansas watershed and applies to scrub woodland in the Cross Timbers. Comments from Station review of the Washita material, indicating need for some changes, were forwarded to SCS.

Although no work was scheduled on the Trinity survey during this period, some additional information was supplied to enable the Fort Worth office to proceed with some basic calculations. Spector spent a week in January in Fort Worth assisting in this. In late March, work on the Trinity and Lower Red surveys was resumed on a full-time basis by Spector and Langdon. The aim is to complete these projects by late April.

Arkansas-White-Red Inter-Agency Study and Related Activities

Meginnis and Stephenson met in Little Rock, January 18, with representatives of the Corps of Engineers' Little Rock and Vicksburg District Offices to coordinate flood survey data and plans for the Lower White and Ouachita Basins. Also participating in the meetings were representatives of State agencies in Missouri and Arkansas. This particular meeting was pursuant to the Inter-Agency job of developing an over-all plan of improvement for the Flood Control-Water Retardation Section of the Arkansas-White-Red Basin Report. The Corps of Engineers has chairmanship of the task force which is handling this phase, with responsibility for coordinating activities.

In addition to affording opportunity for inter-change of data, the conference focused attention on several areas in the Lower White Basin where there is need for unusually close coordination between USDA and the Corps of Engineers.

These are (1) Cane Creek, (2) Little Black River, (3) Current River, and (4) Spring River. In none of these watersheds is there a fully authorized or recommended Corps of Engineers' program. The five reservoirs under consideration (Harviell, Fair Dealing, Blair, Doniphan, and Hardy) are all in a doubtful status due to local opposition or other factors, and hence any plan of improvement developed for purposes of the Inter-Agency study will start from scratch. There was general concurrence that we will have to develop separable forestry programs and evaluations of costs and benefits for each of these watersheds, and that the Corps will need to re-study their respective projects including major reservoir proposals. The final plan of improvement for these sub-watersheds may well be a combination of USDA and Corps of Engineers' measures and there are indications that the Corps may favorably consider dropping parts of their plan if alternative upstream measures afford satisfactory control. It was agreed that when USDA and C of E programs for the Lower White and Ouachita Basins have been tentatively selected, conferences will be held at the field level to reconcile project proposals and harmonize estimates of damages, benefits, etc.

As an outgrowth of this conference, the survey staff has furnished the Little Rock office with information indicative of the effect of the proposed USDA program on the flow of Crooked Creek in the vicinity of Harrison, Arkansas. The Vicksburg office has also been furnished data on floodplain areas, flood frequencies, and flood damages as derived for sample reaches on the number of tributaries of the Ouachita River. Mr. Little of the Vicksburg office visited New Orleans recently to obtain this information and to acquaint himself with survey data and procedures. The Little Rock office has furnished basic hydrologic and economic information bearing on flood damages in the four aforementioned watersheds.

The Inter-Agency Basin study is making increasing demands on the Flood Surveys Division in the form of various jobs of a service nature which contribute to the work of the various subject matter committees. The flood survey staff has furnished considerable information on request, including special computations of drainage areas, summaries of land use statistics, inventories of hydrologic records, and the like. Much additional work of this nature is in prospect, particularly assembly and derivation of background data for the Agriculture-Forestry-Conservation Section of the Basin plan, in which the Station is actively participating.

Flood surveys personnel also participated in an advisory capacity in a service job being handled by the Station's Division of Economics at the request of the Tulsa Corps of Engineers' office. This study is an appraisal of damages to timber and timberlands from present flooding on Little River (Arkansas and Texas) and the potential effects of flooding in the event that Millwood Reservoir, or various alternative impoundments, are constructed.

Influences Research (Tallahatchie Branch)

Broadfoot has prepared a work plan for an investigation of the progressive changes in soil and litter properties occurring in loblolly, shortleaf, red cedar, and mixed cedar-pine plantations. Plans are also under way to study some of the morphological, chemical, and physical properties of several mull humus types and the effects on plant growth.

8489

March 30, 1951

QUARTERLY REPORT
Division of Forest Influences
January-March 1951
Southwestern Forest and Range Experiment Station

Drought has gripped the Southwest almost continuously since 1941. The San Carlos reservoir contains no usable water, and the Salt River reservoir system contains less than 10 percent of its capacity, with very little prospect of much runoff from snow now remaining on the watersheds. Precipitation at Workman Creek for the 6-month period October through March, a period that on the average produces about 63 percent of the year's total, was only 49 percent of the 12-year average and was the lowest on record. Cloud seeding both by airplane and by ground generators has been tried in an effort to assist nature in breaking the drought.

Some people believe in cloud seeding

The Salt River Valley Water Users' Association have artificially seeded clouds by airplane and have attempted to use the water passing their gaging stations as a measure of the success of these operations. It is difficult to evaluate this type of operation since controls are largely lacking, and there is always the question of the rainfall that would have occurred had there been no cloud seeding.

Two sets of favorable clouds were seeded, the first in the spring of 1950 from February 26 through April 8, and the second during the summer of 1950, June 22 through August 31.

The gain in stream flow from the artificial inducement of precipitation by airplane was estimated by the Salt River Valley Water Users' Association at about 12 percent of the total annual flow of the combined Salt and Verde Rivers for 1950. Sixty-three percent of the increase resulted from the seeding of spring clouds and 37 percent from summer clouds. Regardless of the amount of the increase, the Salt River Valley Water Users' Association's evaluation of winter rains producing most of the runoff is similar to that found from studies at Sierra Ancha. The example pointed out by them was July 1950 when 12 precipitation stations on the Salt River and Tonto Creek watersheds averaged 138 percent of normal, yet the runoff was only 79.5 percent of normal. In contrast, the spring flights came at a time when additional precipitation was added to well soaked soils and should have prolonged the runoff.

Ground water has not recharged

Recharge in one of the two observation wells in the Workman Creek area had not started by the end of February. The water level has dropped continuously since February 28, 1950. A slight recharge occurred in the other well beginning February 6, 1951. Other years recharge took place during the last part of December and the first part of January, and the maximum recharge occurred before the end of February.

(Over)

Granite soil problem is critical

The problem of managing granitic soil areas of the Southwest is paramount on a number of forests. The regional forester brought together at the Southwestern Station representatives from the region and six forest supervisors who are directly concerned to discuss granitic soils and to outline procedure to be followed in managing these areas.

The Summit watersheds are located in the heart of the granitic area in central Arizona. Personnel from the Southwestern Station presented data from 25 years of study of these granitic areas. The problems encountered were discussed and ways to manage these lands summarized in part as follows:

1. Mechanical weathering is undoubtedly a dominant factor in most of the granitic areas of the Southwest and the derived soils retain many of the characteristics of the parent material.

2. These granitic soils exhibit most of the characteristics that are common to highly erodible soils such as coarse texture, low clay content in the surface horizon, very little compaction, and large quantities of partially disintegrated parent material.

3. Granitic soils are stable and productive under good plant cover. As long as plant cover is maintained, grazing does not greatly increase erosion.

4. An extremely delicate balance exists between the protective vegetation and erosion. Once this has been broken by abuse, granitic areas become a large source of sediment. This sediment is doing considerable damage in filling irrigation reservoirs and canals.

5. Eroded slopes of small watersheds have not revegetated naturally after 23 years of protection from grazing. The vegetation on granitic areas cannot be abused, then by elimination of abuse, restored, except over an extremely long period of time. The slow recovery of vegetation points up two basic management needs: (a) Elimination of all forms of abuse on areas still in good condition; (b) some aid to recovery on the deteriorated areas, such as reseeding, decreasing the harshness of the microclimate by mulching or shading or mechanical structures.

Working plans are being revised

The problem analysis completed last year is the basis for revising working plans for the Natural Drainages and the Summit watersheds. The purpose of the Natural Drainages study is to determine the effect on water and sediment yields of changing plant cover by various methods of grazing. In addition to carrying on the grazing phase of this study, the effects of fire on water and sediment yields from the grassland-chaparral type will be introduced. Working plans for the Summit area will deal primarily with methods of rehabilitation of granitic areas and the effect of this rehabilitation on water and sediment yields.

Timber cutting treatments being planned

A working plan is being prepared for the Workman Creek area. The pretreatment period on the three Workman Creek watersheds includes climatic extremes--the wet year of 1940-41, the dry year of 1949-50, and what now appears as an even drier year in 1951. These three watersheds have somewhat different stream-flow characteristics as might be expected from a southwest-, a west-, and a northwest-facing watershed. The northwest-facing watershed is the more uniform flowing stream. The Middle Fork, which is a west flowing stream, has a smaller base flow than either the North or South Fork. It had a larger flood flow from one wet year 1940-41, as well as higher runoff during the spring flood season. With these variations during the year, the average yield for the 12-year period of record has been similar for all three watersheds-- 3.34 inches annually for the north-facing watershed, 3.29 inches for the south-facing watershed, and 3.10 inches annually for the Middle or west-facing watershed. Rainfall has averaged 31.64 inches. Stream-flow yield is between 9.8 and 10.6 percent of the rainfall. Correlation on an annual basis varies from 0.9893 to 0.9807. If the north-facing watershed is held as a check--and this appears logical since smaller increases will show significance--the following increases in stream flow for the 5- and 12-year period would be necessary to show that the effect of the timber cutting treatments is greater than might be expected by chance.

	For a 5-year treatment period		For a 12-year treatment period	
	Inches increase necessary	Percent increase necessary	Inches increase necessary	Percent increase necessary
South-facing watershed	0.55	16.7	0.26	8.0
West-facing watershed	0.74	22.0	0.35	10.5

Plans are tentatively under way for initiating treatment on these watersheds in the near future.

Irrigation water in short supply

On the first of March each year an estimate of the runoff in Salt River for the 3-month period March through May is prepared for the Salt River Valley Water Users' Association. This estimate is based on the relationship of the October through February flow of Parker Creek, on the Sierra Ancha Experimental Forest, to the March through May flow of Salt River. This estimated flow for 1951 is 96,000 acre-feet. This estimate may be high, since March precipitation has been deficient and April appears to be following the same pattern. From all indications the flow in Salt River this year will be lower than any year on record.

The storage capacity of the Salt River Valley reservoir system is approximately 2 million acre-feet. As of March 30 there is less than 200,000 acre-feet of stored water in this system. Unless additional precipitation is received which results in greatly increased stream flow, it will be necessary to reduce the amount of water delivered to the farmer this season from 2 acre-feet to 1-1/2 acre-feet. A large part of even this amount must be pumped. The cost of pumping an acre-foot of water at the present time is approximately $2.60 per acre-foot more than the cost of supplying surface water, and the ground water tables are rapidly declining in these pumped areas.